Exercise Sheet

Hypothesis Testing and Confidence Intervals

Ratiomera Statistics

This sheet contains 120 exercises organized into 12 learning-objective groups. Work through each exercise before consulting its matching complete solution. Show the relevant formula or rule, substituted values, units, and an interpretation. All settings, values, data, and software outputs are constructed teaching material; they are not empirical findings.

Part I: Theory

A01: Hypotheses and the Two Possible Errors

`T03-A01-V01`: Guided map practice

A fictional study asks whether the mean route-planning score for learners using guided map practice is higher than the corresponding population mean for learners using the standard activity. Let μ_T and μ_C denote those two population means. (a) Write the null and alternative hypotheses in words and symbols. (b) Explain a Type I error and a Type II error in this setting. (c) State why a test decision cannot reveal with certainty whether either error occurred.

`T03-A01-V02`: Quiet reading spaces

A fictional study asks whether the mean reading-comprehension score for students assigned a quiet reading room is different from the corresponding population mean for students assigned the usual room. Let μ_T and μ_C denote those two population means. (a) Write the null and alternative hypotheses in words and symbols. (b) Explain a Type I error and a Type II error in this setting. (c) State why a test decision cannot reveal with certainty whether either error occurred.

`T03-A01-V03`: Archive-search checklist

A fictional study asks whether the mean number of correctly retrieved records for learners using a search checklist is higher than the corresponding population mean for learners using the ordinary instructions. Let μ_T and μ_C denote those two population means. (a) Write the null and alternative hypotheses in words and symbols. (b) Explain a Type I error and a Type II error in this setting. (c) State why a test decision cannot reveal with certainty whether either error occurred.

`T03-A01-V04`: Short movement break

A fictional study asks whether the mean sustained-attention score for participants offered a short movement break is higher than the corresponding population mean for participants following the usual schedule. Let μ_T and μ_C denote those two population means. (a) Write the null and alternative hypotheses in words and symbols. (b) Explain a Type I error and a Type II error in this setting. (c) State why a test decision cannot reveal with certainty whether either error occurred.

`T03-A01-V05`: Captioned tutorial

A fictional study asks whether the mean tutorial-comprehension score for learners viewing a captioned tutorial is different from the corresponding population mean for learners viewing the same tutorial without captions. Let μ_T and μ_C denote those two population means. (a) Write the null and alternative hypotheses in words and symbols. (b) Explain a Type I error and a Type II error in this setting. (c) State why a test decision cannot reveal with certainty whether either error occurred.

`T03-A01-V06`: Reduced notification setting

A fictional study asks whether the mean task-completion time for participants using a reduced-notification setting is lower than the corresponding population mean for participants using the standard setting. Let μ_T and μ_C denote those two population means. (a) Write the null and alternative hypotheses in words and symbols. (b) Explain a Type I error and a Type II error in this setting. (c) State why a test decision cannot reveal with certainty whether either error occurred.

`T03-A01-V07`: Retrieval-practice cards

A fictional study asks whether the mean delayed-recall score for learners using retrieval-practice cards is higher than the corresponding population mean for learners rereading the same material. Let μ_T and μ_C denote those two population means. (a) Write the null and alternative hypotheses in words and symbols. (b) Explain a Type I error and a Type II error in this setting. (c) State why a test decision cannot reveal with certainty whether either error occurred.

`T03-A01-V08`: Museum orientation map

A fictional study asks whether the mean number of navigation errors for visitors receiving an orientation map is lower than the corresponding population mean for visitors receiving the standard leaflet. Let μ_T and μ_C denote those two population means. (a) Write the null and alternative hypotheses in words and symbols. (b) Explain a Type I error and a Type II error in this setting. (c) State why a test decision cannot reveal with certainty whether either error occurred.

`T03-A01-V09`: Peer explanation prompt

A fictional study asks whether the mean concept-explanation score for students receiving a peer-explanation prompt is different from the corresponding population mean for students receiving an individual review prompt. Let μ_T and μ_C denote those two population means. (a) Write the null and alternative hypotheses in words and symbols. (b) Explain a Type I error and a Type II error in this setting. (c) State why a test decision cannot reveal with certainty whether either error occurred.

`T03-A01-V10`: Structured note template

A fictional study asks whether the mean number of correctly identified arguments for learners using a structured note template is higher than the corresponding population mean for learners taking notes in their usual way. Let μ_T and μ_C denote those two population means. (a) Write the null and alternative hypotheses in words and symbols. (b) Explain a Type I error and a Type II error in this setting. (c) State why a test decision cannot reveal with certainty whether either error occurred.

A09: t Quantiles and Degrees of Freedom

`T03-A09-V01`: Quantiles with 5 degrees of freedom

For a t distribution with 5 degrees of freedom, a reference table gives $t_{0.99}(5) = 3.3649$. (a) State $t_{0.01}(5)$ using symmetry. (b) Explain what each quantile means as a cumulative area. (c) Compare the magnitude with the standard-normal 0.99 quantile 2.3263 and explain what happens as the degrees of freedom increase.

`T03-A09-V02`: Quantiles with 6 degrees of freedom

For a t distribution with 6 degrees of freedom, a reference table gives $t_{0.99}(6) = 3.1427$. (a) State $t_{0.01}(6)$ using symmetry. (b) Explain what each quantile means as a cumulative area. (c) Compare the magnitude with the standard-normal 0.99 quantile 2.3263 and explain what happens as the degrees of freedom increase.

`T03-A09-V03`: Quantiles with 7 degrees of freedom

For a t distribution with 7 degrees of freedom, a reference table gives $t_{0.99}(7) = 2.9980$. (a) State $t_{0.01}(7)$ using symmetry. (b) Explain what each quantile means as a cumulative area. (c) Compare the magnitude with the standard-normal 0.99 quantile 2.3263 and explain what happens as the degrees of freedom increase.

`T03-A09-V04`: Quantiles with 8 degrees of freedom

For a t distribution with 8 degrees of freedom, a reference table gives $t_{0.99}(8) = 2.8965$. (a) State $t_{0.01}(8)$ using symmetry. (b) Explain what each quantile means as a cumulative area. (c) Compare the magnitude with the standard-normal 0.99 quantile 2.3263 and explain what happens as the degrees of freedom increase.

`T03-A09-V05`: Quantiles with 9 degrees of freedom

For a t distribution with 9 degrees of freedom, a reference table gives $t_{0.99}(9) = 2.8214$. (a) State $t_{0.01}(9)$ using symmetry. (b) Explain what each quantile means as a cumulative area. (c) Compare the magnitude with the standard-normal 0.99 quantile 2.3263 and explain what happens as the degrees of freedom increase.

`T03-A09-V06`: Quantiles with 10 degrees of freedom

For a t distribution with 10 degrees of freedom, a reference table gives $t_{0.99}(10) = 2.7638$. (a) State $t_{0.01}(10)$ using symmetry. (b) Explain what each quantile means as a cumulative area. (c) Compare the magnitude with the standard-normal 0.99 quantile 2.3263 and explain what happens as the degrees of freedom increase.

`T03-A09-V07`: Quantiles with 11 degrees of freedom

For a t distribution with 11 degrees of freedom, a reference table gives $t_{0.99}(11) = 2.7181$. (a) State $t_{0.01}(11)$ using symmetry. (b) Explain what each quantile means as a cumulative area. (c) Compare the magnitude with the standard-normal 0.99 quantile 2.3263 and explain what happens as the degrees of freedom increase.

`T03-A09-V08`: Quantiles with 12 degrees of freedom

For a t distribution with 12 degrees of freedom, a reference table gives $t_{0.99}(12) = 2.6810$. (a) State $t_{0.01}(12)$ using symmetry. (b) Explain what each quantile means as a cumulative area. (c) Compare the magnitude with the standard-normal 0.99 quantile 2.3263 and explain what happens as the degrees of freedom increase.

`T03-A09-V09`: Quantiles with 15 degrees of freedom

For a t distribution with 15 degrees of freedom, a reference table gives $t_{0.99}(15) = 2.6025$. (a) State $t_{0.01}(15)$ using symmetry. (b) Explain what each quantile means as a cumulative area. (c) Compare the magnitude with the standard-normal 0.99 quantile 2.3263 and explain what happens as the degrees of freedom increase.

`T03-A09-V10`: Quantiles with 20 degrees of freedom

For a t distribution with 20 degrees of freedom, a reference table gives $t_{0.99}(20) = 2.5280$. (a) State $t_{0.01}(20)$ using symmetry. (b) Explain what each quantile means as a cumulative area. (c) Compare the magnitude with the standard-normal 0.99 quantile 2.3263 and explain what happens as the degrees of freedom increase.

Part II: Calculator Practice

A02: Sample Estimates and the Standard Error

`T03-A02-V01`: Daily reading minutes

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple random sample records the following 9 values in minutes: 32, 41, 28, 35, 46, 39, 31, 44, 37. (a) Calculate the sample mean $\bar{x}$ and sample variance s^2. (b) Name the population parameters estimated by these two statistics. (c) Calculate the plug-in standard error $s/\sqrt{n}$ and explain what it describes across repeated samples.

`T03-A02-V02`: Archive requests completed

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple random sample records the following 8 values in requests: 7, 5, 8, 6, 9, 4, 7, 6. (a) Calculate the sample mean $\bar{x}$ and sample variance s^2. (b) Name the population parameters estimated by these two statistics. (c) Calculate the plug-in standard error $s/\sqrt{n}$ and explain what it describes across repeated samples.

`T03-A02-V03`: Focus ratings

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple random sample records the following 10 values in points: 12, 15, 11, 13, 16, 14, 10, 15, 12, 14. (a) Calculate the sample mean $\bar{x}$ and sample variance s^2. (b) Name the population parameters estimated by these two statistics. (c) Calculate the plug-in standard error $s/\sqrt{n}$ and explain what it describes across repeated samples.

`T03-A02-V04`: Museum visit durations

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple random sample records the following 8 values in minutes: 54, 61, 48, 57, 65, 52, 59, 63. (a) Calculate the sample mean $\bar{x}$ and sample variance s^2. (b) Name the population parameters estimated by these two statistics. (c) Calculate the plug-in standard error $s/\sqrt{n}$ and explain what it describes across repeated samples.

`T03-A02-V05`: Correctly coded records

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple random sample records the following 9 values in records: 18, 21, 17, 20, 22, 19, 23, 16, 21. (a) Calculate the sample mean $\bar{x}$ and sample variance s^2. (b) Name the population parameters estimated by these two statistics. (c) Calculate the plug-in standard error $s/\sqrt{n}$ and explain what it describes across repeated samples.

`T03-A02-V06`: Weekly practice hours

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple random sample records the following 10 values in hours: 4, 6, 5, 7, 3, 8, 5, 6, 4, 7. (a) Calculate the sample mean $\bar{x}$ and sample variance s^2. (b) Name the population parameters estimated by these two statistics. (c) Calculate the plug-in standard error $s/\sqrt{n}$ and explain what it describes across repeated samples.

`T03-A02-V07`: Route-planning scores

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple random sample records the following 9 values in points: 68, 74, 71, 66, 79, 72, 70, 77, 69. (a) Calculate the sample mean $\bar{x}$ and sample variance s^2. (b) Name the population parameters estimated by these two statistics. (c) Calculate the plug-in standard error $s/\sqrt{n}$ and explain what it describes across repeated samples.

`T03-A02-V08`: Response latencies

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple random sample records the following 8 values in seconds: 23, 19, 26, 21, 24, 18, 22, 25. (a) Calculate the sample mean $\bar{x}$ and sample variance s^2. (b) Name the population parameters estimated by these two statistics. (c) Calculate the plug-in standard error $s/\sqrt{n}$ and explain what it describes across repeated samples.

`T03-A02-V09`: Completed diary prompts

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple random sample records the following 9 values in prompts: 9, 11, 8, 10, 12, 7, 9, 10, 11. (a) Calculate the sample mean $\bar{x}$ and sample variance s^2. (b) Name the population parameters estimated by these two statistics. (c) Calculate the plug-in standard error $s/\sqrt{n}$ and explain what it describes across repeated samples.

`T03-A02-V10`: Catalog accuracy scores

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A simple random sample records the following 8 values in points: 84, 88, 81, 86, 90, 83, 87, 85. (a) Calculate the sample mean $\bar{x}$ and sample variance s^2. (b) Name the population parameters estimated by these two statistics. (c) Calculate the plug-in standard error $s/\sqrt{n}$ and explain what it describes across repeated samples.

A03: Known-Sigma Confidence Intervals Across Sample Sizes

`T03-A03-V01`: Four samples of reading score

A population standard deviation of $\sigma = 12$ points is treated as known. Four independent samples give $n = 25$, $\bar{x} = 69$; $n = 49$, $\bar{x} = 74$; $n = 100$, $\bar{x} = 71$; $n = 400$, $\bar{x} = 73$. (a) Calculate the standard error for each sample. (b) Construct each 95% z confidence interval using $\bar{x} \pm 1.96\sigma/\sqrt{n}$. (c) Explain why the intervals have different widths and why the point estimates need not equal the reference population mean 72.

`T03-A03-V02`: Four samples of processing time

A population standard deviation of $\sigma = 10$ minutes is treated as known. Four independent samples give $n = 16$, $\bar{x} = 52$; $n = 36$, $\bar{x} = 46$; $n = 64$, $\bar{x} = 49$; $n = 144$, $\bar{x} = 47$. (a) Calculate the standard error for each sample. (b) Construct each 95% z confidence interval using $\bar{x} \pm 1.96\sigma/\sqrt{n}$. (c) Explain why the intervals have different widths and why the point estimates need not equal the reference population mean 48.

`T03-A03-V03`: Four samples of focus rating

A population standard deviation of $\sigma = 9$ points is treated as known. Four independent samples give $n = 25$, $\bar{x} = 57$; $n = 81$, $\bar{x} = 62$; $n = 121$, $\bar{x} = 61$; $n = 225$, $\bar{x} = 60$. (a) Calculate the standard error for each sample. (b) Construct each 95% z confidence interval using $\bar{x} \pm 1.96\sigma/\sqrt{n}$. (c) Explain why the intervals have different widths and why the point estimates need not equal the reference population mean 60.

`T03-A03-V04`: Four samples of visit duration

A population standard deviation of $\sigma = 18$ minutes is treated as known. Four independent samples give $n = 36$, $\bar{x} = 85$; $n = 64$, $\bar{x} = 94$; $n = 100$, $\bar{x} = 92$; $n = 324$, $\bar{x} = 89$. (a) Calculate the standard error for each sample. (b) Construct each 95% z confidence interval using $\bar{x} \pm 1.96\sigma/\sqrt{n}$. (c) Explain why the intervals have different widths and why the point estimates need not equal the reference population mean 90.

`T03-A03-V05`: Four samples of memory score

A population standard deviation of $\sigma = 15$ points is treated as known. Four independent samples give $n = 25$, $\bar{x} = 101$; $n = 49$, $\bar{x} = 108$; $n = 100$, $\bar{x} = 104$; $n = 225$, $\bar{x} = 106$. (a) Calculate the standard error for each sample. (b) Construct each 95% z confidence interval using $\bar{x} \pm 1.96\sigma/\sqrt{n}$. (c) Explain why the intervals have different widths and why the point estimates need not equal the reference population mean 105.

`T03-A03-V06`: Four samples of sound index

A population standard deviation of $\sigma = 8$ points is treated as known. Four independent samples give $n = 16$, $\bar{x} = 45$; $n = 64$, $\bar{x} = 40$; $n = 144$, $\bar{x} = 43$; $n = 256$, $\bar{x} = 42$. (a) Calculate the standard error for each sample. (b) Construct each 95% z confidence interval using $\bar{x} \pm 1.96\sigma/\sqrt{n}$. (c) Explain why the intervals have different widths and why the point estimates need not equal the reference population mean 42.

`T03-A03-V07`: Four samples of confidence score

A population standard deviation of $\sigma = 11$ points is treated as known. Four independent samples give $n = 25$, $\bar{x} = 51$; $n = 100$, $\bar{x} = 58$; $n = 121$, $\bar{x} = 56$; $n = 400$, $\bar{x} = 55$. (a) Calculate the standard error for each sample. (b) Construct each 95% z confidence interval using $\bar{x} \pm 1.96\sigma/\sqrt{n}$. (c) Explain why the intervals have different widths and why the point estimates need not equal the reference population mean 55.

`T03-A03-V08`: Four samples of response time

A population standard deviation of $\sigma = 80$ milliseconds is treated as known. Four independent samples give $n = 16$, $\bar{x} = 548$; $n = 64$, $\bar{x} = 505$; $n = 100$, $\bar{x} = 530$; $n = 256$, $\bar{x} = 518$. (a) Calculate the standard error for each sample. (b) Construct each 95% z confidence interval using $\bar{x} \pm 1.96\sigma/\sqrt{n}$. (c) Explain why the intervals have different widths and why the point estimates need not equal the reference population mean 520.

`T03-A03-V09`: Four samples of trust rating

A population standard deviation of $\sigma = 7$ points is treated as known. Four independent samples give $n = 25$, $\bar{x} = 47$; $n = 49$, $\bar{x} = 52$; $n = 196$, $\bar{x} = 51$; $n = 400$, $\bar{x} = 50$. (a) Calculate the standard error for each sample. (b) Construct each 95% z confidence interval using $\bar{x} \pm 1.96\sigma/\sqrt{n}$. (c) Explain why the intervals have different widths and why the point estimates need not equal the reference population mean 50.

`T03-A03-V10`: Four samples of accuracy score

A population standard deviation of $\sigma = 6$ points is treated as known. Four independent samples give $n = 36$, $\bar{x} = 84$; $n = 81$, $\bar{x} = 88$; $n = 144$, $\bar{x} = 87$; $n = 324$, $\bar{x} = 86$. (a) Calculate the standard error for each sample. (b) Construct each 95% z confidence interval using $\bar{x} \pm 1.96\sigma/\sqrt{n}$. (c) Explain why the intervals have different widths and why the point estimates need not equal the reference population mean 86.

A04: Confidence Level, Sample Size, and Interval Width

`T03-A04-V01`: Interval width for reading fluency

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample has $\bar{x} = 78$ points, known $\sigma = 12$ points, and $n = 36$. (a) Construct 80%, 90%, 95%, and 99% z confidence intervals using critical values 1.2816, 1.6449, 1.9600, and 2.5758. (b) At the 95% level, compare the interval widths for $n = 9$, $n = 36$, and $n = 144$ while keeping the same mean and standard deviation. (c) Explain separately how confidence level, sample size, and population variability affect interval width.

`T03-A04-V02`: Interval width for archive processing

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample has $\bar{x} = 44$ minutes, known $\sigma = 10$ minutes, and $n = 25$. (a) Construct 80%, 90%, 95%, and 99% z confidence intervals using critical values 1.2816, 1.6449, 1.9600, and 2.5758. (b) At the 95% level, compare the interval widths for $n = 9$, $n = 25$, and $n = 100$ while keeping the same mean and standard deviation. (c) Explain separately how confidence level, sample size, and population variability affect interval width.

`T03-A04-V03`: Interval width for wellbeing index

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample has $\bar{x} = 63$ points, known $\sigma = 15$ points, and $n = 49$. (a) Construct 80%, 90%, 95%, and 99% z confidence intervals using critical values 1.2816, 1.6449, 1.9600, and 2.5758. (b) At the 95% level, compare the interval widths for $n = 16$, $n = 49$, and $n = 196$ while keeping the same mean and standard deviation. (c) Explain separately how confidence level, sample size, and population variability affect interval width.

`T03-A04-V04`: Interval width for museum duration

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample has $\bar{x} = 96$ minutes, known $\sigma = 18$ minutes, and $n = 64$. (a) Construct 80%, 90%, 95%, and 99% z confidence intervals using critical values 1.2816, 1.6449, 1.9600, and 2.5758. (b) At the 95% level, compare the interval widths for $n = 16$, $n = 64$, and $n = 256$ while keeping the same mean and standard deviation. (c) Explain separately how confidence level, sample size, and population variability affect interval width.

T03-A04-V05: Interval width for memory score

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample has $\bar{x} = 108$ points, known $\sigma = 14$ points, and $n = 36$. (a) Construct 80%, 90%, 95%, and 99% z confidence intervals using critical values 1.2816, 1.6449, 1.9600, and 2.5758. (b) At the 95% level, compare the interval widths for $n = 9$, $n = 36$, and $n = 144$ while keeping the same mean and standard deviation. (c) Explain separately how confidence level, sample size, and population variability affect interval width.

T03-A04-V06: Interval width for sound level

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample has $\bar{x} = 39$ decibels, known $\sigma = 6$ decibels, and $n = 25$. (a) Construct 80%, 90%, 95%, and 99% z confidence intervals using critical values 1.2816, 1.6449, 1.9600, and 2.5758. (b) At the 95% level, compare the interval widths for $n = 9$, $n = 25$, and $n = 100$ while keeping the same mean and standard deviation. (c) Explain separately how confidence level, sample size, and population variability affect interval width.

T03-A04-V07: Interval width for course confidence

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample has $\bar{x} = 58$ points, known $\sigma = 10$ points, and $n = 64$. (a) Construct 80%, 90%, 95%, and 99% z confidence intervals using critical values 1.2816, 1.6449, 1.9600, and 2.5758. (b) At the 95% level, compare the interval widths for $n = 16$, $n = 64$, and $n = 256$ while keeping the same mean and standard deviation. (c) Explain separately how confidence level, sample size, and population variability affect interval width.

T03-A04-V08: Interval width for response latency

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample has $\bar{x} = 480$ milliseconds, known $\sigma = 72$ milliseconds, and $n = 36$. (a) Construct 80%, 90%, 95%, and 99% z confidence intervals using critical values 1.2816, 1.6449, 1.9600, and 2.5758. (b) At the 95% level, compare the interval widths for $n = 9$, $n = 36$, and $n = 144$ while keeping the same mean and standard deviation. (c) Explain separately how confidence level, sample size, and population variability affect interval width.

T03-A04-V09: Interval width for community trust

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample has $\bar{x} = 52$ points, known $\sigma = 8$ points, and $n = 49$. (a) Construct 80%, 90%, 95%, and 99% z confidence intervals using critical values 1.2816, 1.6449, 1.9600, and 2.5758. (b) At the 95% level, compare the interval widths for $n = 16$, $n = 49$, and $n = 196$ while keeping the same mean and standard deviation. (c) Explain separately how confidence level, sample size, and population variability affect interval width.

T03-A04-V10: Interval width for catalog accuracy

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample has $\bar{x} = 87$ points, known $\sigma = 7$ points, and $n = 25$. (a) Construct 80%, 90%, 95%, and 99% z confidence intervals using critical values 1.2816, 1.6449, 1.9600, and 2.5758. (b) At the 95% level, compare the interval widths for $n = 9$, $n = 25$, and $n = 100$ while keeping the same mean and standard deviation. (c) Explain separately how confidence level, sample size, and population variability affect interval width.

A05: One-Sided z Tests and the Possible Decision Error

`T03-A05-V01`: Guided route rehearsal

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In this hypothetical teaching setting, the null model specifies $\mu_0 = 70$ and the population standard deviation is treated as known at $\sigma = 10$ points. A random sample of $n = 25$ after the stated procedure has mean $\bar{x} = 72$ points. Test $H_0 : \mu = 70$ against $H_1 : \mu > 70$ at $\alpha = 0.05$. The null value is a claim to be tested, not a population truth supplied in advance. (a) Calculate the z statistic. (b) Use the one-sided critical value 1.6449 in the appropriate tail to decide. (c) Name the statistical error that remains possible after that decision and interpret it for route-planning score.

`T03-A05-V02`: Streamlined archive form

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In this hypothetical teaching setting, the null model specifies $\mu_0 = 45$ and the population standard deviation is treated as known at $\sigma = 8$ minutes. A random sample of $n = 36$ after the stated procedure has mean $\bar{x} = 42$ minutes. Test $H_0 : \mu = 45$ against $H_1 : \mu < 45$ at $\alpha = 0.05$. The null value is a claim to be tested, not a population truth supplied in advance. (a) Calculate the z statistic. (b) Use the one-sided critical value 1.6449 in the appropriate tail to decide. (c) Name the statistical error that remains possible after that decision and interpret it for completion time.

`T03-A05-V03`: Retrieval-practice prompts

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In this hypothetical teaching setting, the null model specifies $\mu_0 = 62$ and the population standard deviation is treated as known at $\sigma = 12$ points. A random sample of $n = 49$ after the stated procedure has mean $\bar{x} = 64$ points. Test $H_0 : \mu = 62$ against $H_1 : \mu > 62$ at $\alpha = 0.05$. The null value is a claim to be tested, not a population truth supplied in advance. (a) Calculate the z statistic. (b) Use the one-sided critical value 1.6449 in the appropriate tail to decide. (c) Name the statistical error that remains possible after that decision and interpret it for delayed-recall score.

`T03-A05-V04`: Orientation map

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In this hypothetical teaching setting, the null model specifies $\mu_0 = 8$ and the population standard deviation is treated as known at $\sigma = 3$ errors. A random sample of $n = 25$ after the stated procedure has mean $\bar{x} = 6.8$ errors. Test $H_0 : \mu = 8$ against $H_1 : \mu < 8$ at $\alpha = 0.05$. The null value is a claim to be tested, not a population truth supplied in advance. (a) Calculate the z statistic. (b) Use the one-sided critical value 1.6449 in the appropriate tail to decide. (c) Name the statistical error that remains possible after that decision and interpret it for navigation-error count.

`T03-A05-V05`: Structured note template

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In this hypothetical teaching setting, the null model specifies $\mu_0 = 55$ and the population standard deviation is treated as known at $\sigma = 9$ points. A random sample of $n = 36$ after the stated procedure has mean $\bar{x} = 56.5$ points. Test $H_0 : \mu = 55$ against $H_1 : \mu > 55$ at $\alpha = 0.05$. The null value is a claim to be tested, not a population truth supplied in advance. (a) Calculate the z statistic. (b) Use the one-sided critical value 1.6449 in the appropriate tail to decide. (c) Name the statistical error that remains possible after that decision and interpret it for argument-identification score.

`T03-A05-V06`: Quiet work period

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In this hypothetical teaching setting, the null model specifies $\mu_0 = 14$ and the population standard deviation is treated as known at $\sigma = 4$ switches. A random sample of $n = 64$ after the stated procedure has mean $\bar{x} = 12.8$ switches. Test $H_0 : \mu = 14$ against $H_1 : \mu < 14$ at $\alpha = 0.05$. The null value is a claim to be tested, not a population truth supplied in advance. (a) Calculate the z statistic. (b) Use the one-sided critical value 1.6449 in the appropriate tail to decide. (c) Name the statistical error that remains possible after that decision and interpret it for task-switch count.

`T03-A05-V07`: Captioned demonstration

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In this hypothetical teaching setting, the null model specifies $\mu_0 = 76$ and the population standard deviation is treated as known at $\sigma = 11$ points. A random sample of $n = 49$ after the stated procedure has mean $\bar{x} = 78$ points. Test $H_0 : \mu = 76$ against $H_1 : \mu > 76$ at $\alpha = 0.05$. The null value is a claim to be tested, not a population truth supplied in advance. (a) Calculate the z statistic. (b) Use the one-sided critical value 1.6449 in the appropriate tail to decide. (c) Name the statistical error that remains possible after that decision and interpret it for comprehension score.

`T03-A05-V08`: Reminder checklist

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In this hypothetical teaching setting, the null model specifies $\mu_0 = 5$ and the population standard deviation is treated as known at $\sigma = 2$ steps. A random sample of $n = 25$ after the stated procedure has mean $\bar{x} = 4.1$ steps. Test $H_0 : \mu = 5$ against $H_1 : \mu < 5$ at $\alpha = 0.05$. The null value is a claim to be tested, not a population truth supplied in advance. (a) Calculate the z statistic. (b) Use the one-sided critical value 1.6449 in the appropriate tail to decide. (c) Name the statistical error that remains possible after that decision and interpret it for missed-step count.

`T03-A05-V09`: Peer explanation

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In this hypothetical teaching setting, the null model specifies $\mu_0 = 68$ and the population standard deviation is treated as known at $\sigma = 10$ points. A random sample of $n = 100$ after the stated procedure has mean $\bar{x} = 69.2$ points. Test $H_0 : \mu = 68$ against $H_1 : \mu > 68$ at $\alpha = 0.05$. The null value is a claim to be tested, not a population truth supplied in advance. (a) Calculate the z statistic. (b) Use the one-sided critical value 1.6449 in the appropriate tail to decide. (c) Name the statistical error that remains possible after that decision and interpret it for reasoning score.

`T03-A05-V10`: Reduced notifications

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In this hypothetical teaching setting, the null model specifies $\mu_0 = 52$ and the population standard deviation is treated as known at $\sigma = 9$ minutes. A random sample of $n = 81$ after the stated procedure has mean $\bar{x} = 50.0$ minutes. Test $H_0 : \mu = 52$ against $H_1 : \mu < 52$ at $\alpha = 0.05$. The null value is a claim to be tested, not a population truth supplied in advance. (a) Calculate the z statistic. (b) Use the one-sided critical value 1.6449 in the appropriate tail to decide. (c) Name the statistical error that remains possible after that decision and interpret it for completion time.

A06: Two-Sided z Tests

T03-A06-V01: Memory-support schedule

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Suppose memory score has reference population mean $\mu_0 = 65$ and known standard deviation $\sigma = 8$ points. A sample of $n = 64$ after the named change has $\bar{x} = 67.5$ points. (a) State a two-sided null and alternative hypothesis. (b) Calculate the z statistic and two-sided p-value. (c) Decide at $\alpha = 0.05$ and interpret the result without claiming that nonsignificance proves no effect.

T03-A06-V02: Revised search protocol

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Suppose search time has reference population mean $\mu_0 = 50$ and known standard deviation $\sigma = 10$ seconds. A sample of $n = 100$ after the named change has $\bar{x} = 48$ seconds. (a) State a two-sided null and alternative hypothesis. (b) Calculate the z statistic and two-sided p-value. (c) Decide at $\alpha = 0.05$ and interpret the result without claiming that nonsignificance proves no effect.

T03-A06-V03: New reading prompt

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Suppose reading-comprehension score has reference population mean $\mu_0 = 72$ and known standard deviation $\sigma = 12$ points. A sample of $n = 36$ after the named change has $\bar{x} = 74$ points. (a) State a two-sided null and alternative hypothesis. (b) Calculate the z statistic and two-sided p-value. (c) Decide at $\alpha = 0.05$ and interpret the result without claiming that nonsignificance proves no effect.

T03-A06-V04: Gallery route signs

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Suppose navigation time has reference population mean $\mu_0 = 40$ and known standard deviation $\sigma = 9$ minutes. A sample of $n = 81$ after the named change has $\bar{x} = 37.5$ minutes. (a) State a two-sided null and alternative hypothesis. (b) Calculate the z statistic and two-sided p-value. (c) Decide at $\alpha = 0.05$ and interpret the result without claiming that nonsignificance proves no effect.

T03-A06-V05: Concept-map format

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Suppose concept score has reference population mean $\mu_0 = 60$ and known standard deviation $\sigma = 10$ points. A sample of $n = 49$ after the named change has $\bar{x} = 61.5$ points. (a) State a two-sided null and alternative hypothesis. (b) Calculate the z statistic and two-sided p-value. (c) Decide at $\alpha = 0.05$ and interpret the result without claiming that nonsignificance proves no effect.

T03-A06-V06: Appointment reminder

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Suppose response delay has reference population mean $\mu_0 = 24$ and known standard deviation $\sigma = 6$ hours. A sample of $n = 64$ after the named change has $\bar{x} = 22$ hours. (a) State a two-sided null and alternative hypothesis. (b) Calculate the z statistic and two-sided p-value. (c) Decide at $\alpha = 0.05$ and interpret the result without claiming that nonsignificance proves no effect.

`T03-A06-V07`: Peer-review structure

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Suppose revision score has reference population mean $\mu_0 = 55$ and known standard deviation $\sigma = 8$ points. A sample of $n = 100$ after the named change has $\bar{x} = 56$ points. (a) State a two-sided null and alternative hypothesis. (b) Calculate the z statistic and two-sided p-value. (c) Decide at $\alpha = 0.05$ and interpret the result without claiming that nonsignificance proves no effect.

`T03-A06-V08`: Document preview tool

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Suppose inspection time has reference population mean $\mu_0 = 35$ and known standard deviation $\sigma = 7$ seconds. A sample of $n = 49$ after the named change has $\bar{x} = 32.5$ seconds. (a) State a two-sided null and alternative hypothesis. (b) Calculate the z statistic and two-sided p-value. (c) Decide at $\alpha = 0.05$ and interpret the result without claiming that nonsignificance proves no effect.

`T03-A06-V09`: Route rehearsal card

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Suppose route-confidence score has reference population mean $\mu_0 = 70$ and known standard deviation $\sigma = 9$ points. A sample of $n = 144$ after the named change has $\bar{x} = 71$ points. (a) State a two-sided null and alternative hypothesis. (b) Calculate the z statistic and two-sided p-value. (c) Decide at $\alpha = 0.05$ and interpret the result without claiming that nonsignificance proves no effect.

`T03-A06-V10`: Annotation display

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Suppose argument score has reference population mean $\mu_0 = 48$ and known standard deviation $\sigma = 6$ points. A sample of $n = 100$ after the named change has $\bar{x} = 46.5$ points. (a) State a two-sided null and alternative hypothesis. (b) Calculate the z statistic and two-sided p-value. (c) Decide at $\alpha = 0.05$ and interpret the result without claiming that nonsignificance proves no effect.

A07: p-Values, Power, and Planned Sample Size

`T03-A07-V01`: Planning a study of guided map practice

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A one-sided upper-tail z test uses $H_0 : \mu = 70$, known $\sigma = 10$ score points, $\alpha = 0.05$, and sample size $n = 36$. The observed sample mean is $\bar{x} = 71.5$. (a) Calculate the z statistic and p-value and make the decision. (b) If the true population mean is $\mu = 74$, calculate power using $1 - \Phi(z_{0.95} - \delta\sqrt{n}/\sigma)$. (c) Find the smallest planned sample size for 90% power using $n = \lceil[(z_{0.95} + z_{0.90})\sigma/\delta]^2\rceil$. Interpret the p-value and power as different conditional probabilities.

`T03-A07-V02`: Planning a study of an archive-search checklist

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A one-sided upper-tail z test uses $H_0 : \mu = 18$, known $\sigma = 5$ correct records, $\alpha = 0.05$, and sample size $n = 49$. The observed sample mean is $\bar{x} = 20$. (a) Calculate the z statistic and p-value and make the decision. (b) If the true population mean is $\mu = 20.5$, calculate power using $1 - \Phi(z_{0.95} - \delta\sqrt{n}/\sigma)$. (c) Find the smallest planned sample size for 90% power using $n = \lceil[(z_{0.95} + z_{0.90})\sigma/\delta]^2\rceil$. Interpret the p-value and power as different conditional probabilities.

T03-A07-V03: Planning a study of retrieval-practice cards

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A one-sided upper-tail z test uses $H_0 : \mu = 60$, known $\sigma = 12$ score points, $\alpha = 0.05$, and sample size $n = 64$. The observed sample mean is $\bar{x} = 61.5$. (a) Calculate the z statistic and p-value and make the decision. (b) If the true population mean is $\mu = 64$, calculate power using $1 - \Phi(z_{0.95} - \delta\sqrt{n}/\sigma)$. (c) Find the smallest planned sample size for 90% power using $n = \lceil[(z_{0.95} + z_{0.90})\sigma/\delta]^2\rceil$. Interpret the p-value and power as different conditional probabilities.

T03-A07-V04: Planning a study of a quiet reading room

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A one-sided upper-tail z test uses $H_0 : \mu = 75$, known $\sigma = 14$ score points, $\alpha = 0.05$, and sample size $n = 49$. The observed sample mean is $\bar{x} = 78.5$. (a) Calculate the z statistic and p-value and make the decision. (b) If the true population mean is $\mu = 80$, calculate power using $1 - \Phi(z_{0.95} - \delta\sqrt{n}/\sigma)$. (c) Find the smallest planned sample size for 90% power using $n = \lceil[(z_{0.95} + z_{0.90})\sigma/\delta]^2\rceil$. Interpret the p-value and power as different conditional probabilities.

T03-A07-V05: Planning a study of a structured note template

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A one-sided upper-tail z test uses $H_0 : \mu = 12$, known $\sigma = 3$ arguments, $\alpha = 0.05$, and sample size $n = 36$. The observed sample mean is $\bar{x} = 12.5$. (a) Calculate the z statistic and p-value and make the decision. (b) If the true population mean is $\mu = 13.5$, calculate power using $1 - \Phi(z_{0.95} - \delta\sqrt{n}/\sigma)$. (c) Find the smallest planned sample size for 90% power using $n = \lceil[(z_{0.95} + z_{0.90})\sigma/\delta]^2\rceil$. Interpret the p-value and power as different conditional probabilities.

T03-A07-V06: Planning a study of a captioned tutorial

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A one-sided upper-tail z test uses $H_0 : \mu = 68$, known $\sigma = 9$ score points, $\alpha = 0.05$, and sample size $n = 81$. The observed sample mean is $\bar{x} = 70$. (a) Calculate the z statistic and p-value and make the decision. (b) If the true population mean is $\mu = 70.5$, calculate power using $1 - \Phi(z_{0.95} - \delta\sqrt{n}/\sigma)$. (c) Find the smallest planned sample size for 90% power using $n = \lceil[(z_{0.95} + z_{0.90})\sigma/\delta]^2\rceil$. Interpret the p-value and power as different conditional probabilities.

T03-A07-V07: Planning a study of a reminder checklist

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A one-sided upper-tail z test uses $H_0 : \mu = 20$, known $\sigma = 4$ completed steps, $\alpha = 0.05$, and sample size $n = 49$. The observed sample mean is $\bar{x} = 20.6$. (a) Calculate the z statistic and p-value and make the decision. (b) If the true population mean is $\mu = 22$, calculate power using $1 - \Phi(z_{0.95} - \delta\sqrt{n}/\sigma)$. (c) Find the smallest planned sample size for 90% power using $n = \lceil[(z_{0.95} + z_{0.90})\sigma/\delta]^2\rceil$. Interpret the p-value and power as different conditional probabilities.

`T03-A07-V08`: Planning a study of peer explanation

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A one-sided upper-tail z test uses $H_0 : \mu = 72$, known $\sigma = 11$ score points, $\alpha = 0.05$, and sample size $n = 100$. The observed sample mean is $\bar{x} = 74.1$. (a) Calculate the z statistic and p-value and make the decision. (b) If the true population mean is $\mu = 75$, calculate power using $1 - \Phi(z_{0.95} - \delta\sqrt{n}/\sigma)$. (c) Find the smallest planned sample size for 90% power using $n = \lceil[(z_{0.95} + z_{0.90})\sigma/\delta]^2\rceil$. Interpret the p-value and power as different conditional probabilities.

`T03-A07-V09`: Planning a study of a museum orientation map

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A one-sided upper-tail z test uses $H_0 : \mu = 50$, known $\sigma = 8$ route points, $\alpha = 0.05$, and sample size $n = 64$. The observed sample mean is $\bar{x} = 51$. (a) Calculate the z statistic and p-value and make the decision. (b) If the true population mean is $\mu = 52.5$, calculate power using $1 - \Phi(z_{0.95} - \delta\sqrt{n}/\sigma)$. (c) Find the smallest planned sample size for 90% power using $n = \lceil[(z_{0.95} + z_{0.90})\sigma/\delta]^2\rceil$. Interpret the p-value and power as different conditional probabilities.

`T03-A07-V10`: Planning a study of a reduced-notification setting

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A one-sided upper-tail z test uses $H_0 : \mu = 55$, known $\sigma = 10$ focus points, $\alpha = 0.05$, and sample size $n = 100$. The observed sample mean is $\bar{x} = 57.0$. (a) Calculate the z statistic and p-value and make the decision. (b) If the true population mean is $\mu = 58$, calculate power using $1 - \Phi(z_{0.95} - \delta\sqrt{n}/\sigma)$. (c) Find the smallest planned sample size for 90% power using $n = \lceil[(z_{0.95} + z_{0.90})\sigma/\delta]^2\rceil$. Interpret the p-value and power as different conditional probabilities.

A08: Two-Sided Testing, Confidence Intervals, and Practical Size

`T03-A08-V01`: Full inference for alternative reading layout

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In an independent hypothetical setting, the reference mean is 210, known $\sigma = 30$ words per minute, $n = 64$, and $\bar{x} = 215$. (a) Construct the 95% confidence interval for μ. (b) Use the interval to make the two-sided 5% test decision about $H_0 : \mu = 210$ and verify it with a p-value. (c) Report the observed mean difference in words per minute and explain why statistical significance alone does not determine whether that difference is practically important.

`T03-A08-V02`: Full inference for new catalog interface

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In an independent hypothetical setting, the reference mean is 75, known $\sigma = 12$ seconds, $n = 49$, and $\bar{x} = 70$. (a) Construct the 95% confidence interval for μ. (b) Use the interval to make the two-sided 5% test decision about $H_0 : \mu = 75$ and verify it with a p-value. (c) Report the observed mean difference in seconds and explain why statistical significance alone does not determine whether that difference is practically important.

`T03-A08-V03`: Full inference for ambient sound setting

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In an independent hypothetical setting, the reference mean is 58, known $\sigma = 10$ points, $n = 36$, and $\bar{x} = 60$. (a) Construct the 95% confidence interval for μ. (b) Use the interval to make the two-sided 5% test decision about $H_0 : \mu = 58$ and verify it with a p-value. (c) Report the observed mean difference in points and explain why statistical significance alone does not determine whether that difference is practically important.

`T03-A08-V04`: Full inference for museum route markers

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In an independent hypothetical setting, the reference mean is 95, known $\sigma = 18$ minutes, $n = 81$, and $\bar{x} = 89$. (a) Construct the 95% confidence interval for μ. (b) Use the interval to make the two-sided 5% test decision about $H_0 : \mu = 95$ and verify it with a p-value. (c) Report the observed mean difference in minutes and explain why statistical significance alone does not determine whether that difference is practically important.

`T03-A08-V05`: Full inference for memory cue format

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In an independent hypothetical setting, the reference mean is 72, known $\sigma = 14$ points, $n = 49$, and $\bar{x} = 75$. (a) Construct the 95% confidence interval for μ. (b) Use the interval to make the two-sided 5% test decision about $H_0 : \mu = 72$ and verify it with a p-value. (c) Report the observed mean difference in points and explain why statistical significance alone does not determine whether that difference is practically important.

`T03-A08-V06`: Full inference for survey reminder wording

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In an independent hypothetical setting, the reference mean is 30, known $\sigma = 8$ hours, $n = 64$, and $\bar{x} = 27$. (a) Construct the 95% confidence interval for μ. (b) Use the interval to make the two-sided 5% test decision about $H_0 : \mu = 30$ and verify it with a p-value. (c) Report the observed mean difference in hours and explain why statistical significance alone does not determine whether that difference is practically important.

`T03-A08-V07`: Full inference for workshop seating plan

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In an independent hypothetical setting, the reference mean is 50, known $\sigma = 9$ points, $n = 100$, and $\bar{x} = 51.2$. (a) Construct the 95% confidence interval for μ. (b) Use the interval to make the two-sided 5% test decision about $H_0 : \mu = 50$ and verify it with a p-value. (c) Report the observed mean difference in points and explain why statistical significance alone does not determine whether that difference is practically important.

`T03-A08-V08`: Full inference for archive image contrast

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In an independent hypothetical setting, the reference mean is 42, known $\sigma = 7$ seconds, $n = 49$, and $\bar{x} = 39.5$. (a) Construct the 95% confidence interval for μ. (b) Use the interval to make the two-sided 5% test decision about $H_0 : \mu = 42$ and verify it with a p-value. (c) Report the observed mean difference in seconds and explain why statistical significance alone does not determine whether that difference is practically important.

`T03-A08-V09`: Full inference for route-description style

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In an independent hypothetical setting, the reference mean is 66, known $\sigma = 12$ points, $n = 144$, and $\bar{x} = 67.5$. (a) Construct the 95% confidence interval for μ. (b) Use the interval to make the two-sided 5% test decision about $H_0 : \mu = 66$ and verify it with a p-value. (c) Report the observed mean difference in points and explain why statistical significance alone does not determine whether that difference is practically important.

`T03-A08-V10`: Full inference for note-taking display

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

In an independent hypothetical setting, the reference mean is 80, known $\sigma = 15$ points, $n = 100$, and $\bar{x} = 76.5$. (a) Construct the 95% confidence interval for μ. (b) Use the interval to make the two-sided 5% test decision about $H_0 : \mu = 80$ and verify it with a p-value. (c) Report the observed mean difference in points and explain why statistical significance alone does not determine whether that difference is practically important.

A10: One-Sample t Tests

`T03-A10-V01`: Testing guided search training

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample of $n = 8$ observations after guided search training has search-accuracy score mean $\bar{x} = 76$ points and sample standard deviation $s = 6.5$ points. The population standard deviation is unknown. Test $H_0 : \mu = 70$ against $H_1 : \mu > 70$ at $\alpha = 0.05$. (a) Explain why the one-sample t procedure is used. (b) Calculate the statistic with 7 degrees of freedom. (c) Compare it with the one-sided critical magnitude 1.8946 and interpret the decision.

`T03-A10-V02`: Testing a shorter intake form

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample of $n = 9$ observations after a shorter intake form has completion time mean $\bar{x} = 41.5$ minutes and sample standard deviation $s = 5.4$ minutes. The population standard deviation is unknown. Test $H_0 : \mu = 45$ against $H_1 : \mu < 45$ at $\alpha = 0.05$. (a) Explain why the one-sample t procedure is used. (b) Calculate the statistic with 8 degrees of freedom. (c) Compare it with the one-sided critical magnitude 1.8595 and interpret the decision.

`T03-A10-V03`: Testing a retrieval cue

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample of $n = 10$ observations after a retrieval cue has recall score mean $\bar{x} = 66$ points and sample standard deviation $s = 6.2$ points. The population standard deviation is unknown. Test $H_0 : \mu = 62$ against $H_1 : \mu > 62$ at $\alpha = 0.05$. (a) Explain why the one-sample t procedure is used. (b) Calculate the statistic with 9 degrees of freedom. (c) Compare it with the one-sided critical magnitude 1.8331 and interpret the decision.

`T03-A10-V04`: Testing an orientation card

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample of $n = 11$ observations after an orientation card has navigation-error count mean $\bar{x} = 7.1$ errors and sample standard deviation $s = 3.8$ errors. The population standard deviation is unknown. Test $H_0 : \mu = 9$ against $H_1 : \mu < 9$ at $\alpha = 0.05$. (a) Explain why the one-sample t procedure is used. (b) Calculate the statistic with 10 degrees of freedom. (c) Compare it with the one-sided critical magnitude 1.8125 and interpret the decision.

`T03-A10-V05`: Testing a structured note page

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample of $n = 12$ observations after a structured note page has argument score mean $\bar{x} = 57.5$ points and sample standard deviation $s = 5.5$ points. The population standard deviation is unknown. Test $H_0 : \mu = 54$ against $H_1 : \mu > 54$ at $\alpha = 0.05$. (a) Explain why the one-sample t procedure is used. (b) Calculate the statistic with 11 degrees of freedom. (c) Compare it with the one-sided critical magnitude 1.7959 and interpret the decision.

`T03-A10-V06`: Testing a quiet work block

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample of $n = 13$ observations after a quiet work block has task-switch count mean $\bar{x} = 13.0$ switches and sample standard deviation $s = 4.0$ switches. The population standard deviation is unknown. Test $H_0 : \mu = 15$ against $H_1 : \mu < 15$ at $\alpha = 0.05$. (a) Explain why the one-sample t procedure is used. (b) Calculate the statistic with 12 degrees of freedom. (c) Compare it with the one-sided critical magnitude 1.7823 and interpret the decision.

`T03-A10-V07`: Testing a captioned demonstration

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample of $n = 14$ observations after a captioned demonstration has comprehension score mean $\bar{x} = 77.2$ points and sample standard deviation $s = 6.0$ points. The population standard deviation is unknown. Test $H_0 : \mu = 74$ against $H_1 : \mu > 74$ at $\alpha = 0.05$. (a) Explain why the one-sample t procedure is used. (b) Calculate the statistic with 13 degrees of freedom. (c) Compare it with the one-sided critical magnitude 1.7709 and interpret the decision.

`T03-A10-V08`: Testing a reminder checklist

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample of $n = 15$ observations after a reminder checklist has missed-step count mean $\bar{x} = 4.9$ steps and sample standard deviation $s = 2.1$ steps. The population standard deviation is unknown. Test $H_0 : \mu = 6$ against $H_1 : \mu < 6$ at $\alpha = 0.05$. (a) Explain why the one-sample t procedure is used. (b) Calculate the statistic with 14 degrees of freedom. (c) Compare it with the one-sided critical magnitude 1.7613 and interpret the decision.

`T03-A10-V09`: Testing peer explanation

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample of $n = 16$ observations after peer explanation has reasoning score mean $\bar{x} = 69.6$ points and sample standard deviation $s = 5.3$ points. The population standard deviation is unknown. Test $H_0 : \mu = 67$ against $H_1 : \mu > 67$ at $\alpha = 0.05$. (a) Explain why the one-sample t procedure is used. (b) Calculate the statistic with 15 degrees of freedom. (c) Compare it with the one-sided critical magnitude 1.7531 and interpret the decision.

`T03-A10-V10`: Testing a reduced-notification setting

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A sample of $n = 17$ observations after a reduced-notification setting has completion time mean $\bar{x} = 47.8$ minutes and sample standard deviation $s = 4.9$ minutes. The population standard deviation is unknown. Test $H_0 : \mu = 50$ against $H_1 : \mu < 50$ at $\alpha = 0.05$. (a) Explain why the one-sample t procedure is used. (b) Calculate the statistic with 16 degrees of freedom. (c) Compare it with the one-sided critical magnitude 1.7459 and interpret the decision.

A11: One-Sample t Confidence Intervals and Test Duality

`T03-A11-V01`: Estimating mean reading fluency

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A random sample of $n = 8$ has $\bar{x} = 76$ points and $s = 7$ points. A t table gives $t_{0.975}(7) = 2.3646$. (a) Construct a 95% confidence interval for the population mean. (b) Use the interval to test $H_0 : \mu = 70$ against $H_1 : \mu \neq 70$ at 5%. (c) Explain why the interval and matching two-sided test agree and state the correct repeated-sampling interpretation of 95% confidence.

`T03-A11-V02`: Estimating mean archive processing

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A random sample of $n = 9$ has $\bar{x} = 43$ minutes and $s = 6$ minutes. A t table gives $t_{0.975}(8) = 2.3060$. (a) Construct a 95% confidence interval for the population mean. (b) Use the interval to test $H_0 : \mu = 47$ against $H_1 : \mu \neq 47$ at 5%. (c) Explain why the interval and matching two-sided test agree and state the correct repeated-sampling interpretation of 95% confidence.

`T03-A11-V03`: Estimating mean focus rating

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A random sample of $n = 10$ has $\bar{x} = 61$ points and $s = 8$ points. A t table gives $t_{0.975}(9) = 2.2622$. (a) Construct a 95% confidence interval for the population mean. (b) Use the interval to test $H_0 : \mu = 55$ against $H_1 : \mu \neq 55$ at 5%. (c) Explain why the interval and matching two-sided test agree and state the correct repeated-sampling interpretation of 95% confidence.

`T03-A11-V04`: Estimating mean museum duration

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A random sample of $n = 11$ has $\bar{x} = 92$ minutes and $s = 15$ minutes. A t table gives $t_{0.975}(10) = 2.2281$. (a) Construct a 95% confidence interval for the population mean. (b) Use the interval to test $H_0 : \mu = 100$ against $H_1 : \mu \neq 100$ at 5%. (c) Explain why the interval and matching two-sided test agree and state the correct repeated-sampling interpretation of 95% confidence.

`T03-A11-V05`: Estimating mean memory score

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A random sample of $n = 12$ has $\bar{x} = 106$ points and $s = 10$ points. A t table gives $t_{0.975}(11) = 2.2010$. (a) Construct a 95% confidence interval for the population mean. (b) Use the interval to test $H_0 : \mu = 100$ against $H_1 : \mu \neq 100$ at 5%. (c) Explain why the interval and matching two-sided test agree and state the correct repeated-sampling interpretation of 95% confidence.

`T03-A11-V06`: Estimating mean sound index

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A random sample of $n = 13$ has $\bar{x} = 40$ points and $s = 5$ points. A t table gives $t_{0.975}(12) = 2.1788$. (a) Construct a 95% confidence interval for the population mean. (b) Use the interval to test $H_0 : \mu = 43$ against $H_1 : \mu \neq 43$ at 5%. (c) Explain why the interval and matching two-sided test agree and state the correct repeated-sampling interpretation of 95% confidence.

T03-A11-V07: Estimating mean confidence score

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A random sample of $n = 14$ has $\bar{x} = 57$ points and $s = 7$ points. A t table gives $t_{0.975}(13) = 2.1604$. (a) Construct a 95% confidence interval for the population mean. (b) Use the interval to test $H_0 : \mu = 52$ against $H_1 : \mu \neq 52$ at 5%. (c) Explain why the interval and matching two-sided test agree and state the correct repeated-sampling interpretation of 95% confidence.

T03-A11-V08: Estimating mean response latency

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A random sample of $n = 15$ has $\bar{x} = 490$ milliseconds and $s = 54$ milliseconds. A t table gives $t_{0.975}(14) = 2.1448$. (a) Construct a 95% confidence interval for the population mean. (b) Use the interval to test $H_0 : \mu = 520$ against $H_1 : \mu \neq 520$ at 5%. (c) Explain why the interval and matching two-sided test agree and state the correct repeated-sampling interpretation of 95% confidence.

T03-A11-V09: Estimating mean trust rating

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A random sample of $n = 16$ has $\bar{x} = 51$ points and $s = 6$ points. A t table gives $t_{0.975}(15) = 2.1314$. (a) Construct a 95% confidence interval for the population mean. (b) Use the interval to test $H_0 : \mu = 48$ against $H_1 : \mu \neq 48$ at 5%. (c) Explain why the interval and matching two-sided test agree and state the correct repeated-sampling interpretation of 95% confidence.

T03-A11-V10: Estimating mean catalog accuracy

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

A random sample of $n = 17$ has $\bar{x} = 86$ points and $s = 5$ points. A t table gives $t_{0.975}(16) = 2.1199$. (a) Construct a 95% confidence interval for the population mean. (b) Use the interval to test $H_0 : \mu = 83$ against $H_1 : \mu \neq 83$ at 5%. (c) Explain why the interval and matching two-sided test agree and state the correct repeated-sampling interpretation of 95% confidence.

A12: Pooled Independent-Samples t Tests

T03-A12-V01: Comparing guided versus self-directed map practice

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two independent groups are compared on route-planning score. Group 1 has $n_1 = 10$, $\bar{x}_1 = 74$, and $s_1^2 = 36$; Group 2 has $n_2 = 10$, $\bar{x}_2 = 68$, and $s_2^2 = 25$. Use the registered equal-population-variance model. (a) Explain why the samples are independent rather than paired. (b) Calculate the pooled variance, standard error, and t statistic for the directional alternative $\mu_1 > \mu_2$. (c) Compare with the one-sided critical value 1.7341 at $\alpha = 0.05$ and interpret the result. (d) State the key design and model conditions.

T03-A12-V02: Comparing captioned versus uncaptioned tutorials

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two independent groups are compared on comprehension score. Group 1 has $n_1 = 11$, $\bar{x}_1 = 79$, and $s_1^2 = 30$; Group 2 has $n_2 = 11$, $\bar{x}_2 = 74$, and $s_2^2 = 28$. Use the registered equal-population-variance model. (a) Explain why the samples are independent rather than paired. (b) Calculate the pooled variance, standard error, and t statistic for the directional alternative $\mu_1 > \mu_2$. (c) Compare with the one-sided critical value 1.7247 at $\alpha = 0.05$ and interpret the result. (d) State the key design and model conditions.

`T03-A12-V03`: Comparing quiet versus usual reading rooms

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two independent groups are compared on reading score. Group 1 has $n_1 = 12$, $\bar{x}_1 = 82$, and $s_1^2 = 42$; Group 2 has $n_2 = 12$, $\bar{x}_2 = 76$, and $s_2^2 = 35$. Use the registered equal-population-variance model. (a) Explain why the samples are independent rather than paired. (b) Calculate the pooled variance, standard error, and t statistic for the directional alternative $\mu_1 > \mu_2$. (c) Compare with the one-sided critical value 1.7171 at $\alpha = 0.05$ and interpret the result. (d) State the key design and model conditions.

`T03-A12-V04`: Comparing checklist versus usual archive searches

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two independent groups are compared on correctly retrieved records. Group 1 has $n_1 = 13$, $\bar{x}_1 = 22$, and $s_1^2 = 9$; Group 2 has $n_2 = 13$, $\bar{x}_2 = 19$, and $s_2^2 = 12$. Use the registered equal-population-variance model. (a) Explain why the samples are independent rather than paired. (b) Calculate the pooled variance, standard error, and t statistic for the directional alternative $\mu_1 > \mu_2$. (c) Compare with the one-sided critical value 1.7109 at $\alpha = 0.05$ and interpret the result. (d) State the key design and model conditions.

`T03-A12-V05`: Comparing structured versus free-form notes

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two independent groups are compared on argument score. Group 1 has $n_1 = 14$, $\bar{x}_1 = 61$, and $s_1^2 = 28$; Group 2 has $n_2 = 14$, $\bar{x}_2 = 56$, and $s_2^2 = 32$. Use the registered equal-population-variance model. (a) Explain why the samples are independent rather than paired. (b) Calculate the pooled variance, standard error, and t statistic for the directional alternative $\mu_1 > \mu_2$. (c) Compare with the one-sided critical value 1.7056 at $\alpha = 0.05$ and interpret the result. (d) State the key design and model conditions.

`T03-A12-V06`: Comparing orientation map versus standard leaflet

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two independent groups are compared on navigation score. Group 1 has $n_1 = 15$, $\bar{x}_1 = 70$, and $s_1^2 = 40$; Group 2 has $n_2 = 15$, $\bar{x}_2 = 65$, and $s_2^2 = 36$. Use the registered equal-population-variance model. (a) Explain why the samples are independent rather than paired. (b) Calculate the pooled variance, standard error, and t statistic for the directional alternative $\mu_1 > \mu_2$. (c) Compare with the one-sided critical value 1.7011 at $\alpha = 0.05$ and interpret the result. (d) State the key design and model conditions.

`T03-A12-V07`: Comparing peer explanation versus private rereading

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two independent groups are compared on reasoning score. Group 1 has $n_1 = 16$, $\bar{x}_1 = 73$, and $s_1^2 = 25$; Group 2 has $n_2 = 16$, $\bar{x}_2 = 69$, and $s_2^2 = 30$. Use the registered equal-population-variance model. (a) Explain why the samples are independent rather than paired. (b) Calculate the pooled variance, standard error, and t statistic for the directional alternative $\mu_1 > \mu_2$. (c) Compare with the one-sided critical value 1.6973 at $\alpha = 0.05$ and interpret the result. (d) State the key design and model conditions.

`T03-A12-V08`: Comparing reduced versus usual notifications

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two independent groups are compared on focus score. Group 1 has $n_1 = 17$, $\bar{x}_1 = 64$, and $s_1^2 = 34$; Group 2 has $n_2 = 17$, $\bar{x}_2 = 60$, and $s_2^2 = 38$. Use the registered equal-population-variance model. (a) Explain why the samples are independent rather than paired. (b) Calculate the pooled variance, standard error, and t statistic for the directional alternative $\mu_1 > \mu_2$. (c) Compare with the one-sided critical value 1.6939 at $\alpha = 0.05$ and interpret the result. (d) State the key design and model conditions.

`T03-A12-V09`: Comparing retrieval cards versus summary rereading

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two independent groups are compared on delayed-recall score. Group 1 has $n_1 = 18$, $\bar{x}_1 = 77$, and $s_1^2 = 45$; Group 2 has $n_2 = 18$, $\bar{x}_2 = 72$, and $s_2^2 = 41$. Use the registered equal-population-variance model. (a) Explain why the samples are independent rather than paired. (b) Calculate the pooled variance, standard error, and t statistic for the directional alternative $\mu_1 > \mu_2$. (c) Compare with the one-sided critical value 1.6909 at $\alpha = 0.05$ and interpret the result. (d) State the key design and model conditions.

`T03-A12-V10`: Comparing visual versus text-only route guidance

Reason first. Before calculating, state the relationship, rule, or expected pattern that makes the calculation appropriate.

Two independent groups are compared on route-completion score. Group 1 has $n_1 = 19$, $\bar{x}_1 = 81$, and $s_1^2 = 50$; Group 2 has $n_2 = 19$, $\bar{x}_2 = 76$, and $s_2^2 = 44$. Use the registered equal-population-variance model. (a) Explain why the samples are independent rather than paired. (b) Calculate the pooled variance, standard error, and t statistic for the directional alternative $\mu_1 > \mu_2$. (c) Compare with the one-sided critical value 1.6883 at $\alpha = 0.05$ and interpret the result. (d) State the key design and model conditions.