RATIOMERA

Exercise Sheet

Descriptive Statistics

Ratiomera Statistics

This sheet contains 150 exercises organized into 15 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: Deciding Whether a Mean Is Meaningful

`T01-A01-V01`: Community-library variables

For each variable, decide whether an arithmetic mean is meaningful and justify your answer from what the values represent: library branch code, minutes spent reading, service rating from poor to excellent, room temperature in Fahrenheit, and number of borrowed items.

`T01-A01-V02`: Theater-festival records

Evaluate whether a mean would answer a sensible question for each variable: ticket category, performance duration in minutes, seat row rank, calendar year of a premiere, and number of curtain calls. Explain any assumptions.

`T01-A01-V03`: Urban-garden observations

For plot label, soil moisture percentage, ordered plant-health class, temperature in Celsius, and count of flowering plants, state whether averaging is defensible. Separate numeric codes from quantitative measurements.

`T01-A01-V04`: Language-workshop data

Assess the meaning of a mean for participant badge number, practice time in hours, proficiency band, standardized fluency score, and number of completed modules. Give a one-sentence reason for each decision.

`T01-A01-V05`: Public-transport records

Consider route identifier, journey time, satisfaction category, departure time represented as clock time, and transfer count. Decide whether an ordinary arithmetic mean is interpretable for each and note any special problem with clock time.

`T01-A01-V06`: Museum-collection fields

Would a mean be meaningful for accession number, object mass, conservation-priority rank, year created, and number of documented restorations? Explain the information encoded by each scale before deciding.

`T01-A01-V07`: Coastal-observation log

Judge the use of an arithmetic mean for station name, wave height, warning level, east-west map coordinate in kilometers relative to a fixed local origin, and number of seabirds observed. Distinguish average differences from ratio interpretations where relevant.

`T01-A01-V08`: Digital-archive workflow

For file-format category, processing duration, urgency rank, timestamp within a 24-hour cycle, and page count, decide whether a mean has a defensible interpretation. State when a specialized circular summary would be preferable.

T01-A01-V09: Community-choir records

Evaluate the mean for voice section, rehearsal attendance percentage, audition rank, pitch measured in hertz, and missed-session count. Justify each answer without relying on whether the values happen to be written as numbers.

T01-A01-V10: Food-cooperative inventory

For supplier ID, delivery mass, freshness grade, storage temperature in Celsius, and damaged-item count, decide whether an arithmetic mean is meaningful. Name the defining property that supports or prevents averaging.

A02: Measurement Levels, Including Numeric Identifiers

T01-A02-V01: Variables in a neighborhood arts survey

Classify each variable as nominal, ordinal, interval, ratio, or absolute: mural ID 4107, preferred art form, juror placement (first through fifth), studio temperature in Celsius, paint volume in liters, and number of submitted designs. For each, name the property that determines its level and warn against treating the ID as a quantity.

T01-A02-V02: Records from a public library

Determine the measurement level of borrower code 80314, book genre, damage condition (none, light, moderate, severe), calendar year of publication, shelf length in centimeters, and number of renewals. Explain which comparisons are meaningful for each variable.

T01-A02-V03: Data from a walking-route study

Classify route number 62, surface type, difficulty category, east-west map coordinate in meters relative to an arbitrary local origin, route distance in kilometers, and pedestrian count. Distinguish labels, ordered categories, equal intervals, meaningful ratios, and counts.

T01-A02-V04: Community-theater measurements

Assign a level of measurement to costume tag 229, production genre, audience-prize ranking, backstage temperature in Fahrenheit, performance duration in minutes, and number of scene changes. Justify every classification.

T01-A02-V05: Variables in a coastal-monitoring file

Classify sensor serial number 77105, shoreline material, erosion-risk class, observation year, water depth in meters, and number of nesting sites. State why a numeric-looking identifier remains nominal.

T01-A02-V06: A digital-humanities dataset

For manuscript record code 9908, writing-system category, preservation rank, historical year on a common calendar, digitized file size in megabytes, and count of annotated pages, identify the measurement level and the admissible comparisons.

T01-A02-V07: Food-cooperative delivery data

Classify vendor number 318, product category, freshness grade, storage temperature in Celsius, shipment mass in kilograms, and number of crates. Explain whether ordering, differences, ratios, or counting operations are defensible.

T01-A02-V08: Information from a music workshop

Determine the scale level of participant code 6042, instrument family, audition placement, tuning offset in cents, practice duration in hours, and number of pieces performed. Give a concise rationale for each.

T01-A02-V09: Municipal-service records

Classify request ID 55190, service department, priority level, date represented as a calendar year, response time in hours, and number of follow-up calls. Separate the visual form of the recorded value from its statistical meaning.

T01-A02-V10: Ecological field observations

Identify the measurement level of plot label 702, habitat class, canopy-condition rank, elevation relative to sea level in meters, trunk diameter in centimeters, and tree count. State what kind of transformation would preserve each variable's meaning.

A03: Choosing Mean, Median, and Mode

T01-A03-V01: Farmers-market summaries

For vendor category, customer waiting time, ordered freshness rating, stall number, and basket cost, choose among mean, median, mode, or a useful combination. Explain why each chosen statistic respects the variable and when distribution shape changes your choice.

T01-A03-V02: Community-radio data

Choose defensible measures of center for program genre, episode duration, listener ranking of favorite episodes, station call sign, and weekly donation amount. State whether skew or extreme values would alter the recommendation.

T01-A03-V03: Public-archive requests

Select the mean, median, mode, or more than one for request type, processing days, urgency category, archive box code, and number of pages delivered. Give a scale-based and shape-based reason for each choice.

T01-A03-V04: Bicycle-share records

Recommend center summaries for bicycle model, trip duration, maintenance-priority rank, docking-station ID, and rider age in years. Explain where the median may be more representative than the mean.

T01-A03-V05: Adult-learning workshop data

For workshop format, attendance hours, confidence category, registration number, and score on a 0–100 assessment, decide which center statistic or statistics to report. State any assumption needed for a mean.

T01-A03-V06: Neighborhood-tree inventory

Choose suitable measures of center for tree species, trunk circumference, health class, inventory tag, and number of visible cavities. Address both measurement level and likely skew.

T01-A03-V07: Cultural-festival records

For event type, event length, audience satisfaction band, venue code, and attendance count, recommend mean, median, mode, or combinations. Explain why a technically available mean can still be a poor description.

T01-A03-V08: Local-bus service data

Select appropriate center summaries for route category, delay in minutes, crowding level, vehicle identifier, and distance traveled. Explain how a strongly right-skewed delay distribution affects the answer.

T01-A03-V09: Oral-history catalog data

Choose measures of center for interview language, recording length, sound-quality rank, catalog number, and count of indexed themes. Justify each choice and identify any variable for which center is not informative beyond a mode.

T01-A03-V10: Community-kitchen records

For meal category, preparation time, ordered spice level, recipe ID, and servings produced, decide which center measures are valid and which are likely useful. Distinguish validity from representativeness.

A12: Comparing Alternative Graphics of the Same Data

T01-A12-V01: Library visits on two vertical scales

Quarterly visits in hundreds are 120, 126, 129, and 132. Graphic A is a line chart with a y-axis from 0 to 140; Graphic B uses the same points and a y-axis from 118 to 134. Calculate the absolute and percentage change from first to last quarter, compare the impressions, and choose the more informative display for a general report.

T01-A12-V02: On-time service percentages

A service's monthly on-time percentages are 82%, 84%, 85%, and 86%. One bar chart starts at 0%; another starts at 80%. Calculate the percentage-point and relative changes from month 1 to month 4. Explain how the two axes alter apparent magnitude and recommend labeling.

T01-A12-V03: Park-use pictograms

Three parks recorded 240, 252, and 258 visits. Graphic A uses equal-width bars from zero. Graphic B uses person icons whose height and width both grow in proportion to the values. Compare the actual proportional differences with the area-based visual encoding and identify the defensible graphic.

T01-A12-V04: Survey shares in flat and 3D bars

Two response options received 48% and 52%. Graphic A shows flat bars with a zero baseline; Graphic B starts at 45% and uses perspective so the nearer bar appears wider. Quantify the percentage-point gap, explain both distortions, and state how to redraw the comparison.

T01-A12-V05: Event registrations in chronological and reordered displays

Registrations across four weeks are 310, 300, 315, and 320. A line chart preserves week order; a bar chart rearranges the weeks from lowest to highest. Calculate the net change and identify which display answers a trend question and which answers a rank question. Explain why order matters.

T01-A12-V06: Recycling rates under two baselines

Neighborhood recycling rates are 61%, 63%, 64%, and 66%. Compare a dot plot on a 0%–100% scale with one on a 60%–67% scale. Calculate the first-to-last percentage-point change and explain when the narrower scale can be acceptable.

T01-A12-V07: Donation values shown with circles

Two community funds received 40 and 50 thousand dollars. Graphic A uses bar lengths proportional to value; Graphic B uses circles whose diameters are proportional to value. Compute the true value ratio and the circle-area ratio. Which encoding supports an accurate comparison?

T01-A12-V08: Water use on a reversed axis

Daily water use falls from 90 to 86 to 84 units. One line chart has values increasing upward; another reverses the y-axis, placing smaller values higher. Calculate the total and percentage decrease and explain how the reversed axis changes the apparent direction.

T01-A12-V09: Response rates and unequal bar widths

Two survey rounds have response rates of 71% and 73%. A conventional chart uses equal-width bars; an alternative makes the second bar twice as wide. Calculate the percentage-point gap and compare bar-area impressions. State what visual property should represent the values.

T01-A12-V10: Time-use shares in 3D pie and horizontal bars

A project allocates 35%, 30%, 20%, and 15% of its time to four activities. Compare a tilted 3D pie chart that places the 20% slice at the front with a labeled horizontal bar chart from zero. Verify the total, explain the perspective problem, and choose the display that best supports comparisons.

A13: Diagnosing and Repairing a Misleading Graph

T01-A13-V01: A truncated attendance chart

A bar chart compares attendance of 492 and 508 but begins its y-axis at 488 and labels neither the break nor the sample periods. Diagnose the visual and contextual problems, calculate the true relative difference using 492 as the reference, and specify a repaired graph.

T01-A13-V02: Unequal histogram bins drawn as counts

A histogram uses bins of widths 2, 5, and 10 with frequencies 20, 35, and 45 among $n = 100$ observations, but plots frequency as bar height. Explain why area no longer represents relative frequency, calculate the relative-frequency densities $h_j = n_j/(nw_j)$, and describe the repair.

T01-A13-V03: A dual-axis community dashboard

A dashboard plots volunteer hours from 400 to 520 on the left axis and satisfaction from 3.8 to 4.2 on the right, choosing scales that make the lines overlap. Explain why the overlap does not establish association and propose one or two transparent alternatives.

T01-A13-V04: Irregular dates with equal spacing

A line chart places measurements from January, February, July, and December at equal horizontal distances. Values are 20, 22, 31, and 32. Diagnose the time-axis distortion and state how to display elapsed time honestly.

T01-A13-V05: A tilted pie chart for program enrollment

Program shares are 38%, 33%, 17%, and 12%, but a 3D tilt makes the front 17% slice appear largest. Identify the perceptual problem, verify the percentages, and propose a repair that supports accurate ranking.

T01-A13-V06: Cumulative totals labeled as monthly activity

A line chart shows cumulative requests of 40, 85, 135, and 190 but is titled "Requests per month." Recover the actual monthly counts, explain why a cumulative series cannot decrease when counts are nonnegative, and redesign the labels or data.

T01-A13-V07: Scaled icons for workshop participation

Participation rises from 25 to 30. An infographic enlarges both the height and width of a person icon by the ratio $30/25$. Calculate the true participation ratio and the resulting area ratio, diagnose the exaggeration, and specify a one-dimensional encoding.

T01-A13-V08: A selected time window for river levels

A report displays only four rising days, 2.1, 2.3, 2.5, and 2.7 meters, from a 30-day record and claims a month-long upward trend. Explain the selection problem, calculate the displayed increase, and list the full-period information required.

T01-A13-V09: Small multiples with incompatible scales

Two panels show neighborhood noise measurements. Panel A spans 40–90 units; Panel B spans 58–62 units, yet the panels have equal height and no scale warning. Explain why visual slopes and variation cannot be compared directly and describe a consistent redesign.

T01-A13-V10: A percentage without its denominator

A chart announces that "60% participated," uses a large filled icon, and omits that 12 of the 20 people with recorded participation took part, while 30 additional invitees had no recorded response. Diagnose the denominator and missingness issues and propose a graph and caption that disclose the available evidence.

Part II: Calculator Practice

A04: Quantifying an Extreme Value's Effect on the Mean

T01-A04-V01: Reading-session counts

Six participants completed 8, 9, 10, 10, 11, 12 reading sessions. Calculate the mean and median. A recording error changes 12 to 42. Recalculate both, quantify each change, and explain the contrast.

T01-A04-V02: Exhibit-viewing times

Viewing times in minutes are 14, 15, 16, 16, 17, 18. Find the original mean and median. Replace 18 with 48, then compute the new summaries and state which statistic is more resistant.

T01-A04-V03: Trail-section distances

Six mapped distances in kilometers are 3, 4, 5, 5, 6, 7. After a unit-entry mistake, 7 is stored as 31. Calculate both means and medians, report their numerical changes, and interpret the effect.

T01-A04-V04: Digitized-page totals

Daily page totals are 18, 20, 21, 21, 22, 24. Recalculate the mean and median after 24 is replaced by 84. Show the arithmetic and compare sensitivity.

T01-A04-V05: Queue durations

Waiting times in minutes are 5, 6, 7, 7, 8, 9. One value is later entered as 39 rather than 9. Compute the original and altered means and medians, then explain why the summaries move by different amounts.

T01-A04-V06: Workshop attendance totals

Attendance across six sessions is 22, 23, 24, 24, 25, 26. Suppose 26 is replaced by the implausible value 62. Find both versions of the mean and median and quantify the impact.

T01-A04-V07: Archive-quality scores

Quality scores are 31, 33, 34, 34, 35, 37. A faulty import turns 37 into 85. Calculate and compare the original and altered means and medians. What should an analyst do before deciding whether to remove 85?

T01-A04-V08: Completed community tasks

The counts are 2, 3, 4, 4, 5, 6. Replacing 6 with 30 creates an extreme observation. Compute the old and new mean and median, then describe what each statistic communicates.

T01-A04-V09: Recorded interview lengths

Interview lengths in minutes are 46, 48, 50, 50, 52, 54. One duration is stored as 114 instead of 54. Calculate both pairs of center measures and explain the change in ordinary language.

T01-A04-V10: Seedling-survival counts

Six plot counts are 11, 12, 13, 13, 14, 15. A data error replaces 15 with 57. Find the original and revised means and medians, quantify their changes, and state why checking the raw record matters.

A05: Computing and Comparing Group Medians

T01-A05-V01: Two gallery rooms

Visitor dwell times are Room North: 7, 11, 8, 10, 14 minutes and Room South: 9, 13, 12, 8, 15 minutes. Sort each group, calculate its median, and interpret the comparison without making a causal claim.

T01-A05-V02: Two cataloging teams

Completed records are Team Cedar: 18, 15, 21, 17, 20, 16 and Team Maple: 14, 19, 13, 22, 18, 17. Find both medians using the even-sample rule and describe the difference.

T01-A05-V03: Two walking routes

Travel times are Route Lake: 32, 27, 35, 29, 31 minutes and Route Hill: 38, 34, 30, 41, 36 minutes. Compute and compare the medians, including units.

T01-A05-V04: Two public workshops

Participant question counts are Workshop Clay: 3, 7, 5, 4, 6, 8 and Workshop Print: 2, 9, 4, 5, 3, 7. Order the data, obtain each median, and explain what the result does not reveal about spread.

T01-A05-V05: Two oral-history collections

Recording lengths are Collection Harbor: 41, 55, 48, 62, 50 minutes and Collection Orchard: 39, 44, 57, 46, 52 minutes. Calculate the medians and state the descriptive comparison.

T01-A05-V06: Two community gardens

Harvest counts are Garden East: 24, 19, 28, 22, 31, 26 and Garden West: 17, 25, 23, 29, 21, 27. Compute both medians and explain why the sample result alone does not establish a population difference.

T01-A05-V07: Two reading circles

Pages discussed are Circle Amber: 12, 20, 16, 18, 14 and Circle Indigo: 15, 21, 19, 13, 17. Find and compare the medians after sorting.

T01-A05-V08: Two repair desks

Daily case times are Desk One: 26, 18, 24, 30, 22, 20 minutes and Desk Two: 17, 29, 25, 21, 27, 23 minutes. Determine the group medians and interpret the numerical gap.

T01-A05-V09: Two language exchanges

Conversation turns are Exchange Birch: 44, 38, 51, 47, 42 and Exchange Pine: 36, 49, 45, 53, 41. Calculate the two medians and note one additional summary needed for a fuller comparison.

T01-A05-V10: Two conservation crews

Surveyed plots are Crew Ridge: 9, 14, 11, 16, 13, 12 and Crew Valley: 8, 15, 10, 17, 14, 11. Sort, compute both medians, and describe the result in context.

A06: Sequential Mean and Median Tasks

T01-A06-V01: Weekly translation pages

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

The five totals are 4, 6, 7, 8, 5. (a) Find the median and mean. (b) If the fifth value were hidden but the five-value mean were known to be 6, recover it. (c) Replace that recovered value with 25 and recompute both summaries. (d) Explain the different reactions to the extreme value.

T01-A06-V02: Community-call durations

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

Durations in minutes are 12, 14, 15, 17, 12. Compute median and mean, recover the fifth duration from a stated overall mean of 14, then replace it with 42 and recompute. Discuss whether the new mean represents a typical call.

T01-A06-V03: Field-note entries

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

The daily entry counts are 20, 22, 24, 26, 23. Calculate center, infer the fifth value when only the first four and mean 23 are known, and examine what happens when that value is instead 58. Interpret both changes.

T01-A06-V04: Neighborhood-meeting questions

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

Question counts are $7, 9, 10, 11, 8$. Find mean and median, solve for the fifth count from mean 9, and then substitute 28 for that count. Recalculate and explain outlier sensitivity.

T01-A06-V05: Archive-box processing

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

Processing times are $30, 32, 34, 36, 33$ minutes. Work sequentially: compute mean and median, reconstruct the fifth time from mean 33, replace it by 78, recompute, and assess which summary remains representative.

T01-A06-V06: Rehearsal-break counts

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

The counts are $2, 4, 5, 6, 3$. Calculate both center measures, recover the last value from mean 4, then change it to 18. Show every calculation and explain the outcome.

T01-A06-V07: Market-stall visitors

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

Counts in hundreds are $40, 44, 46, 50, 45$. Determine the mean and median, infer the fifth count from mean 45, and compare them after replacing it with 85. State the practical interpretation.

T01-A06-V08: Exhibit-label word counts

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

Word counts in tens are $9, 11, 12, 13, 10$. Compute mean and median, solve the missing-fifth-value version using mean 11, then set the fifth value to 35 and recalculate. Explain why the order-based statistic behaves differently.

T01-A06-V09: Habitat-survey durations

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

Durations in minutes are $16, 18, 20, 22, 19$. Find the initial summaries, recover the fifth duration from mean 19, and assess the replacement value 54. Include formulas and a contextual conclusion.

T01-A06-V10: Cooperative-delivery totals

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

Daily totals are $24, 26, 28, 30, 27$. Calculate mean and median, reconstruct the fifth total from the known mean of 27, then replace it with 72. Recompute and explain which center measure better reflects four of the five days.

A07: Pooled Medians and Value Replacement

T01-A07-V01: Pooling two reading groups

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

Group Elm recorded $2, 5, 8, 11, 14$ chapters and Group Ash recorded $3, 6, 9, 12, 15$. (a) Calculate the pooled median. (b) Replace 5 with 10 and recalculate. (c) Return to the original data, replace 15 with 60, and recalculate. Explain why the two replacements affect the median differently.

T01-A07-V02: Combining two market periods

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

Morning basket counts are 10, 14, 18, 22, 26; afternoon counts are 12, 16, 20, 24, 28. Find the pooled median, then find it after 14 becomes 21. Separately, find it when the original maximum 28 becomes 80. Interpret the changes.

T01-A07-V03: Merging two archive shelves

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

Shelf Green has page bundles 1, 4, 7, 10, 13; Shelf Gold has 2, 5, 8, 11, 14. Compute the pooled median. Recompute after replacing 4 with 9, and again from the original data after replacing 14 with 40. Relate each result to the middle positions.

T01-A07-V04: Pooling two walking sessions

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

Step totals in hundreds are Session A: 30, 35, 40, 45, 50 and Session B: 32, 37, 42, 47, 52. Calculate the pooled median, then assess replacements 35 to 44 and, separately, 52 to 100. Show the ordered values around the center.

T01-A07-V05: Combining two workshop tables

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

Completed items are Table River: 6, 9, 12, 15, 18 and Table Forest: 7, 10, 13, 16, 19. Find the pooled median. Recalculate when 9 becomes 14, then restore the original data and let 19 become 49. Explain the outcomes.

T01-A07-V06: Pooling two survey zones

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

Recorded households are Zone North: 21, 24, 27, 30, 33 and Zone South: 22, 25, 28, 31, 34. Compute the pooled median before and after 24 is replaced by 29. In a separate change, replace the original 34 by 74. Compare effects.

T01-A07-V07: Combining two rehearsal sets

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

Measure counts are Set Copper: 4, 8, 12, 16, 20 and Set Silver: 6, 10, 14, 18, 22. Calculate the pooled median. Recalculate after changing 8 to 15 and, separately from the original, after changing 22 to 70. Explain using ranks.

T01-A07-V08: Pooling two visitor streams

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

Visitor totals are Stream East: 100, 110, 120, 130, 140 and Stream West: 105, 115, 125, 135, 145. Find the pooled median. Examine a replacement of 110 by 128, then a separate replacement of 145 by 300. State why magnitude alone does not determine the median.

T01-A07-V09: Combining two conservation teams

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

Survey counts are Team Moss: 13, 17, 21, 25, 29 and Team Fern: 15, 19, 23, 27, 31. Determine the pooled median, then recompute after 17 becomes 24. Return to the original values and replace 31 with 71. Interpret.

T01-A07-V10: Pooling two delivery windows

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

Crate totals are Window Early: $50, 55, 60, 65, 70$ and Window Late: $52, 57, 62, 67, 72$. Calculate the pooled median. Recalculate after changing 55 to 64 and, separately, after changing the original 72 to 150. Identify the two middle ranks each time.

A08: Mean, Mode, Sample Variance, Sample SD, and Range

T01-A08-V01: Story-circle contributions

For the contribution counts $2, 4, 4, 6, 6, 6, 8, 12$, calculate the mean, mode, corrected sample variance s^2, sample standard deviation s, and range. Show deviations and squared deviations, and round s^2 and s to two decimals.

T01-A08-V02: Exhibit label lengths

For label lengths in lines $5, 7, 7, 9, 9, 9, 11, 15$, compute the mean, mode, corrected sample variance, sample SD, and range. Display the sum of squared deviations before dividing by $n - 1$.

T01-A08-V03: Community-session questions

Use the values $3, 3, 5, 7, 7, 9, 11, 11$. Find the mean, every mode, sample variance, sample SD, and range. Explain what multiple modes mean for this dataset.

T01-A08-V04: Cataloging times

The times in minutes are $10, 12, 12, 13, 15, 15, 15, 16$. Calculate all five requested summaries: mean, mode, corrected sample variance, sample SD, and range. Keep values unrounded during the calculation, then round s^2 and s to two decimals and show that rounding.

T01-A08-V05: Daily repair requests

For counts $1, 2, 2, 3, 4, 4, 4, 12$, calculate mean, mode, sample variance, sample SD, and range. Comment on how the largest count affects center and spread.

T01-A08-V06: Audio-segment durations

Segment durations are $20, 22, 23, 23, 24, 24, 24, 28$ seconds. Determine the mean, mode, corrected sample variance, sample SD, and range, with a squared-deviation calculation.

T01-A08-V07: Garden-plot observations

The observation counts are $4, 6, 7, 7, 7, 8, 9, 12$. Compute mean, mode, sample variance, sample SD, and range. Keep values unrounded during the calculation, then round s^2 and s to two decimals and show that rounding.

T01-A08-V08: Workshop check-in times

Minutes after opening are $30, 32, 34, 34, 36, 38, 38, 38$. Find the mean, mode, corrected sample variance, sample SD, and range. Include units in the interpretation.

T01-A08-V09: Indexed-theme counts

For $9, 10, 10, 11, 12, 12, 13, 19$, calculate the mean, all modes, sample variance, sample SD, and range. Explain why the mean alone does not reveal the unusual upper value.

T01-A08-V10: Community-delivery intervals

Intervals in minutes are $38, 40, 40, 42, 42, 42, 44, 48$. Compute the mean, mode, corrected sample variance, sample SD, and range. Show the denominator used for the sample variance.

A09: Equal Means Do Not Imply Similar Distributions

T01-A09-V01: Two neighborhood reading programs

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

Program Brook has scores $4, 5, 6, 7, 8$; Program Field has $0, 3, 6, 9, 12$. Verify that their means agree, then compare ranges and sample SDs. Explain why equal means do not make the distributions interchangeable.

T01-A09-V02: Two archive workflows

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

Completion times are Workflow Pine: $18, 19, 20, 21, 22$ and Workflow Stone: $10, 15, 20, 25, 30$. Calculate both means, ranges, and sample SDs, then write a descriptive conclusion.

T01-A09-V03: Two public-speaking groups

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

Turn counts are Group Coral: $7, 9, 10, 11, 13$ and Group Slate: $2, 4, 10, 16, 18$. Show that the means match, calculate each range and corrected sample SD, and identify what the mean conceals.

T01-A09-V04: Two community-event schedules

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

Event lengths are Schedule Oak: $28, 29, 30, 31, 32$ minutes and Schedule Reed: $10, 20, 30, 40, 50$ minutes. Compute means, ranges, and sample SDs. Which schedule is more homogeneous?

T01-A09-V05: Two garden harvest patterns

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

Plot counts are Pattern Sun: $2, 4, 6, 8, 10$ and Pattern Shade: $0, 0, 6, 12, 12$. Verify equal means and compare range, sample SD, and shape. Explain why reporting only the mean would be inadequate.

T01-A09-V06: Two museum tour routes

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

Tour times are Route Glass: $48, 49, 50, 51, 52$ minutes and Route Wood: $20, 35, 50, 65, 80$ minutes. Calculate the common mean and each range and sample SD. Interpret variability in ordinary language.

T01-A09-V07: Two local-history workshops

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

Attendance totals are Workshop Ink: $11, 13, 15, 17, 19$ and Workshop Paper: $3, 9, 15, 21, 27$. Compare mean, range, and sample SD, then state what an organizer would miss by reporting only average attendance.

T01-A09-V08: Two coastal survey windows

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

Observation counts are Window Dawn: $70, 72, 74, 76, 78$ and Window Dusk: $50, 62, 74, 86, 98$. Demonstrate equal means, calculate each range and corrected sample SD, and compare consistency.

T01-A09-V09: Two rehearsal sequences

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

Measure counts are Sequence Bell: $1, 3, 5, 7, 9$ and Sequence Drum: $-7, -1, 5, 11, 17$, where negative values represent changes from a baseline. Find means, ranges, and sample SDs and explain the difference in variability.

T01-A09-V10: Two delivery routes

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

Travel times are Route Lime: $23, 24, 25, 26, 27$ minutes and Route Plum: $5, 15, 25, 35, 45$ minutes. Verify the common mean, compare range and sample SD, and state which route is more predictable descriptively.

A10: Linear Transformations of Mean, Variance, and SD

T01-A10-V01: Rescaling an engagement index

An index x has $\bar{x} = 12$ and $s_x^2 = 9$. Scores are transformed by $y = 5 + 2x$. Calculate $\bar{y}$, s_y^2, and s_y, showing how the additive and multiplicative constants act.

T01-A10-V02: Converting a timing score

A timing variable has $\bar{x} = 20$ and $s_x^2 = 16$. For $y = -3 + 0.5x$, find the transformed mean, variance, and SD. Interpret the effect of multiplying by 0.5.

T01-A10-V03: Reversing a quality scale

A quality measure has $\bar{x} = 8$, $s_x^2 = 25$, and transformation $y = 40 - 3x$. Compute $\bar{y}$, s_y^2, and s_y. Explain why the negative slope reverses order but does not make spread negative.

T01-A10-V04: Expanding a participation score

For $\bar{x} = 15$, $s_x^2 = 4$, and $y = 10 + 4x$, calculate $\bar{y}$, s_y^2, and s_y. State which parts are affected by adding 10.

T01-A10-V05: Recalibrating a field index

A field index has mean 30 and variance 36. It is recoded as $y = -5 + 1.5x$. Determine $\bar{y}$, s_y^2, and s_y, retaining exact values.

T01-A10-V06: Reflecting a response scale

A response score has $\bar{x} = 6$ and $s_x^2 = 49$. Under $y = 2 - 2x$, calculate transformed mean, variance, and SD. Explain the roles of the shift and reflection.

T01-A10-V07: Compressing an archive index

An archive index has $\bar{x} = 50$, $s_x^2 = 64$, and is transformed through $y = 100 + 0.25x$. Compute all three transformed summaries and explain the reduced spread.

T01-A10-V08: Shifting a conservation score

For a score with $\bar{x} = 18$, $s_x^2 = 100$, use $y = -20 + 1.2x$. Find the new mean, variance, and SD. Separate the influence of -20 from that of 1.2.

T01-A10-V09: Enlarging a short rating scale

A composite rating has $\bar{x} = 9$ and $s_x^2 = 1.44$. With $y = 7 + 5x$, compute $\bar{y}$, s_y^2, and s_y. Give the transformed SD in the new unit.

T01-A10-V10: Reversing and shrinking a duration index

An index has $\bar{x} = 42$, $s_x^2 = 121$, and $y = 3 - 0.8x$. Calculate the transformed mean, variance, and SD. Explain why variance uses the square of -0.8.

A11: Z-Standardization

T01-A11-V01: Standardizing reading counts

For $x = (10, 12, 14, 16, 18)$, compute $\bar{x}$, the corrected sample SD, and every $z_i = (x_i - \bar{x})/s_x$. Then verify from the unrounded z-scores that their mean is 0 and corrected sample SD is 1. Round displayed z-scores to three decimals.

T01-A11-V02: Standardizing catalog totals

Use $x = (24, 26, 28, 28, 29)$. Calculate the sample mean and SD, transform all observations to z-scores, and verify the z-score mean and sample SD. Interpret the smallest and largest z-scores.

T01-A11-V03: Standardizing workshop durations

For durations $x = (7, 12, 13, 13, 15)$, obtain $\bar{x}$, s_x, and all standardized values. Demonstrate algebraically or numerically that z-standardization produces mean 0 and sample SD 1.

T01-A11-V04: Standardizing visitor-flow indices

Given $x = (40, 43, 44, 48, 50)$, calculate the corrected sample SD and each z-score. Verify the two defining z-scale summaries and explain what $z = 0$ means here.

T01-A11-V05: Standardizing archive-size measures

For $x = (106, 113, 115, 117, 119)$, compute the sample mean, sample SD, and all z-scores. Check their mean and corrected sample SD using unrounded values and interpret one positive score.

T01-A11-V06: Standardizing field-observation totals

Use $x = (14, 21, 24, 26, 30)$. Standardize the five observations with the corrected sample SD, verify mean 0 and sample SD 1, and explain the sign of each nonzero z-score.

T01-A11-V07: Standardizing rehearsal lengths

For $x = (51, 55, 61, 65, 68)$, calculate $\bar{x}$, s_x, and every z-score. Verify the standardized summaries and interpret the distance of 68 from the original mean in SD units.

T01-A11-V08: Standardizing community-event counts

Given $x = (21, 25, 33, 35, 41)$, compute the corrected sample SD, standardize every value, and verify the transformed mean and SD. State why the units disappear.

T01-A11-V09: Standardizing digitization times

For $x = (83, 87, 91, 94, 95)$ minutes, obtain all z-scores using the sample mean and corrected sample SD. Check mean 0 and sample SD 1, and interpret the z-score for 83.

T01-A11-V10: Standardizing survey-volume totals

Use $x = (137, 141, 143, 146, 153)$. Compute the sample mean and SD, transform the data, verify the z-scale summaries, and state which observations lie above the mean.

A14: Constructing and Interpreting a Histogram and Boxplot

T01-A14-V01: Reading-circle session lengths

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

The lengths are $3, 4, 4, 5, 6, 7, 8, 9, 10, 18$ minutes. Build a frequency table for bins $[0, 5)$, $[5, 10)$, $[10, 15)$, $[15, 20]$, including frequency, relative frequency, width, and density. Find median, mode, quartiles, IQR, fences, and flagged observations. Describe the histogram and boxplot together.

T01-A14-V02: Archive retrieval times

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

Use $11, 12, 13, 13, 14, 15, 16, 17, 18, 27$ minutes and bins $[10, 15), [15, 20), [20, 25), [25, 30]$. Build a table with frequency, relative frequency, width, and relative-frequency density. Calculate the mode, five-number summary, IQR, Tukey fences, and flagged observations, then compare what the histogram and boxplot emphasize.

T01-A14-V03: Community-survey completion times

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

For $20, 21, 22, 23, 23, 24, 25, 26, 27, 36$ minutes, use bins $[20, 25), [25, 30), [30, 35), [35, 40]$. Calculate frequencies, proportions, widths, densities, median, mode, Q_1, Q_3, IQR, fences, and potential outliers. Interpret shape and spread.

T01-A14-V04: Gallery-stop durations

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

The values are $5, 6, 7, 7, 8, 9, 10, 11, 12, 21$ minutes. Use bins $[5, 10), [10, 15), [15, 20), [20, 25]$. Prepare the histogram and box plot, complete all center, quartile, fence, and outlier calculations, and then write a joint interpretation.

T01-A14-V05: Daily cataloging counts

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

Use $30, 31, 32, 33, 33, 34, 35, 36, 37, 47$ and bins $[30, 35), [35, 40), [40, 45), [45, 50]$. Construct the histogram table and boxplot quantities, determine whether any value crosses a Tukey fence, and explain the visible asymmetry.

T01-A14-V06: Neighborhood-help requests

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

The counts are $2, 3, 4, 5, 5, 6, 7, 8, 9, 16$. Use bins $[0, 5), [5, 10), [10, 15), [15, 20]$. Calculate all frequencies and densities as well as median, mode, quartiles, IQR, fences, and flagged points. Compare the information retained by each graph.

T01-A14-V07: Audio-clip durations

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

For $40, 41, 42, 43, 43, 44, 45, 46, 47, 58$ seconds, use bins $[40, 45), [45, 50), [50, 55), [55, 60]$. Prepare the histogram table, compute the boxplot statistics and center measures, and interpret the isolated high value.

T01-A14-V08: Workshop activity totals

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

Use $12, 13, 14, 15, 15, 16, 17, 18, 19, 29$ and bins $[10, 15), [15, 20), [20, 25), [25, 30]$. Find the complete histogram and boxplot inputs, including density and Tukey fences, and describe the distribution without assuming a population model.

T01-A14-V09: Field-note line counts

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

The counts are $60, 61, 62, 63, 63, 64, 65, 66, 67, 77$. Use bins $[60, 65), [65, 70), [70, 75), [75, 80]$. Calculate the table, center, quartiles, IQR, fences, and flagged values, then explain what each graph contributes.

T01-A14-V10: Cooperative order sizes

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

For $24, 25, 26, 27, 27, 28, 29, 30, 31, 41$, use bins $[20, 25), [25, 30), [30, 35), [35, 40), [40, 45]$. Construct and interpret the histogram and boxplot, reporting median, mode, quartiles, IQR, fences, and any potential outlier.

A15: Comparing Histogram Bin Widths and Origins

T01-A15-V01: Workshop-item totals at two widths

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

Use $2, 3, 4, 4, 5, 6, 7, 8, 9, 10, 11, 12$. Compare Scheme A: $[0, 4), [4, 8), [8, 12), [12, 16]$ with Scheme B: $[2, 4), [4, 6), [6, 8), [8, 10), [10, 12), [12, 14]$. Build both frequency tables and compare the shapes.

T01-A15-V02: Retrieval times under shifted origins

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

For $11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22$, compare bins $[10, 15), [15, 20), [20, 25]$ with $[8, 13), [13, 18), [18, 23]$. Calculate frequencies and densities and explain the origin effect.

T01-A15-V03: Visitor counts at coarse and fine widths

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

Use $30, 31, 31, 32, 33, 35, 36, 38, 39, 40, 42, 44$. Compare $[30, 35), [35, 40), [40, 45]$ with $[29, 32), [32, 35), [35, 38), [38, 41), [41, 44), [44, 47]$. Complete both tables and discuss visible clusters.

T01-A15-V04: Reading times under shifted four-unit bins

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

For $5, 6, 7, 8, 9, 10, 10, 11, 12, 13, 14, 15$, compare $[4, 8), [8, 12), [12, 16]$ with $[2, 6), [6, 10), [10, 14), [14, 18]$. Compute both histograms' frequencies and densities and identify any impression created by the shift.

T01-A15-V05: Delivery intervals at two resolutions

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

Use $50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72$. Compare eight-unit bins $[48, 56), [56, 64), [64, 72), [72, 80]$ with four-unit bins $[50, 54), [54, 58), [58, 62), [62, 66), [66, 70), [70, 74]$. Explain what the finer view adds.

T01-A15-V06: Catalog indices under shifted six-unit bins

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

For $101, 102, 104, 105, 107, 108, 110, 111, 113, 114, 116, 118$, compare $[100, 106), [106, 112), [112, 118), [118, 124]$ with $[98, 104), [104, 110), [110, 116), [116, 122]$. Build the frequency-density tables and discuss origin sensitivity.

`T01-A15-V07`: Survey counts at five- and three-unit widths

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

Use $20, 20, 21, 22, 24, 25, 27, 28, 30, 31, 33, 35$. Compare $[20, 25), [25, 30), [30, 35), [35, 40]$ with $[19, 22), [22, 25), [25, 28), [28, 31), [31, 34), [34, 37]$. Calculate and interpret both representations.

`T01-A15-V08`: Event durations with a shifted origin

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

For $7, 9, 10, 12, 13, 15, 16, 18, 19, 21, 22, 24$, compare $[6, 12), [12, 18), [18, 24), [24, 30]$ with $[3, 9), [9, 15), [15, 21), [21, 27]$. Report both tables and explain which apparent grouping comes from the bin definitions.

`T01-A15-V09`: Evenly spaced scan totals

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

Use $200, 203, 206, 209, 212, 215, 218, 221, 224, 227, 230, 233$. Compare twelve-unit bins $[198, 210), [210, 222), [222, 234]$ with six-unit bins $[200, 206), [206, 212), [212, 218), [218, 224), [224, 230), [230, 236]$. Determine whether the conclusion about uniformity is stable.

`T01-A15-V10`: Clustered route durations

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

For $41, 42, 43, 47, 48, 49, 53, 54, 55, 59, 60, 61$, compare ten-unit bins $[40, 50), [50, 60), [60, 70]$ with six-unit bins $[40, 46), [46, 52), [52, 58), [58, 64]$. Calculate frequencies and densities and explain why one scheme can mask or suggest grouping.