LESSON 3.2.3

Repeated Readings and Anomalous Results

Repeats help you judge scatter. An unusual result is a reason to investigate, not permission to erase inconvenient evidence.

REPEAT AT ONE SETTING

Measure the same quantity again with the independent variable fixed. Reset the measurement procedure where appropriate; do not just copy the display.

SAMPLE ACROSS THE RANGE

Use several independent-variable settings to reveal the relationship. Many repeats at one setting cannot establish the whole trend.

WHAT REPEATS CAN AND CANNOT DO

REVEAL SCATTER

Compare readings under the same conditions; a wider spread means poorer precision.

SUPPORT A MEAN

Average suitable readings to reduce the effect of random variation on the result.

FLAG UNUSUAL VALUES

A reading far from the others may indicate a fault, a changed condition or real behaviour.

LEAVE BIAS UNRESOLVED

Repeats alone do not correct a zero offset, a miscalibrated scale or a flawed method.

If values drift steadily, check conditions before pooling them into one mean.

1 Keep the record; justify the choice

Illustrative measurements of spring extension at a fixed load, using a 0.1 mm readout.

RAW READINGS AND OBSERVATIONS

Trial	Extension / mm	Observation / use in calculation
1	32.0	Stable setup; include
2	32.2	Stable setup; include
3	39.5	Reference support visibly slipped; exclude
4	31.8	Reset and checked; include
5	32.0	Additional check; include

Trial 3 is excluded because a measurement fault was observed, not simply because its value was high. The original reading and reason remain in the record.

CALCULATE FROM THE FOUR INCLUDED READINGS

$$\text{Mean} = \frac{32.0 + 32.2 + 31.8 + 32.0}{4} = 32.0 \text{ mm}$$

$$\text{Half-range} = \frac{32.2 - 31.8}{2} = 0.2 \text{ mm}$$

$$\text{Percentage uncertainty} = \frac{0.2}{32.0} \times 100\% = 0.625\%$$

Repeat-spread estimate: (32.0 ± 0.2) mm, or about 0.6%.

Half-range estimates the observed spread, not a statistical confidence interval. Check instrument and method uncertainty too. Here, 0.2 mm exceeds the 0.05 mm half-resolution estimate.

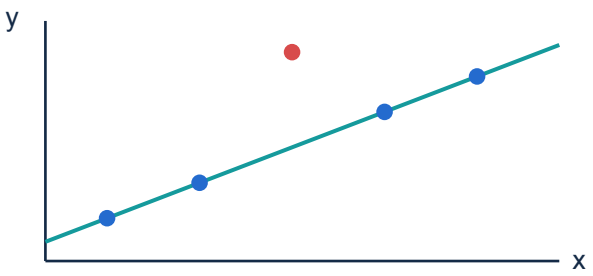
No confirmed fault? Repeat and investigate before deciding what to exclude.

Do not invent a replacement reading or silently remove the original.

2 Investigate before rejecting

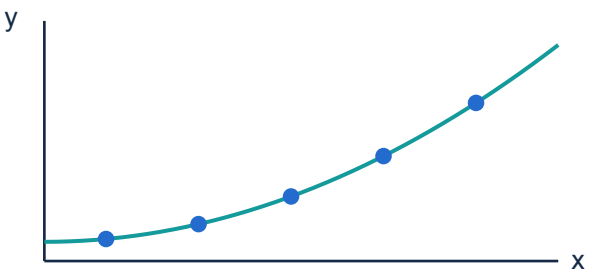
Schematic graphs: an isolated departure and a reproducible curve call for different checks.

ONE UNUSUAL POINT



check this measurement

REPEATED CURVATURE



reconsider the model

1. Flag and inspect

Keep the reading. Check transcription, units, zero, alignment, loose connections and whether a control variable changed.

2. Repeat the relevant setting

Check or reset the apparatus and measure again. Add nearby settings if needed to distinguish an isolated problem from a changing relationship.

3. Use evidence to decide

A documented fault can justify exclusion. A repeatable unusual result may be genuine. If unresolved, report the uncertainty and how the choice affects the conclusion.

4. Report transparently

State which readings were used, why any were excluded, the mean and uncertainty, and the specific improvement the evidence suggests.

Source alignment: Pearson IAL Physics specification, Unit 3 pp. 25-26.

Lesson numbering follows the Jimlaoshi course sequence.