

Test a relationship without declaring a cause

Preserve observation pairs, describe an association accurately, and design a next comparison that can distinguish rival explanations.



An upward pattern without a causal verdict

Fictional case: a training simulation pairs setting indices 1-6 with response scores 4,5,5,7,8,8. These exact pairs remain in the core scatter plot. Learner Ben is asked whether increasing the setting causes a better response. The numbers are synthetic indices, with no machine operating meaning or calibrated prediction rule.

Your role and the reference condition

Improvement analyst with the process owner

Normal: Each plotted point represents one intact paired observation. Units, context and possible shared influences are recorded; conclusions match the evidence.

Gap: The team sorts setting and response separately, then proposes a machine adjustment from the positive-looking graph.

Work within these conditions

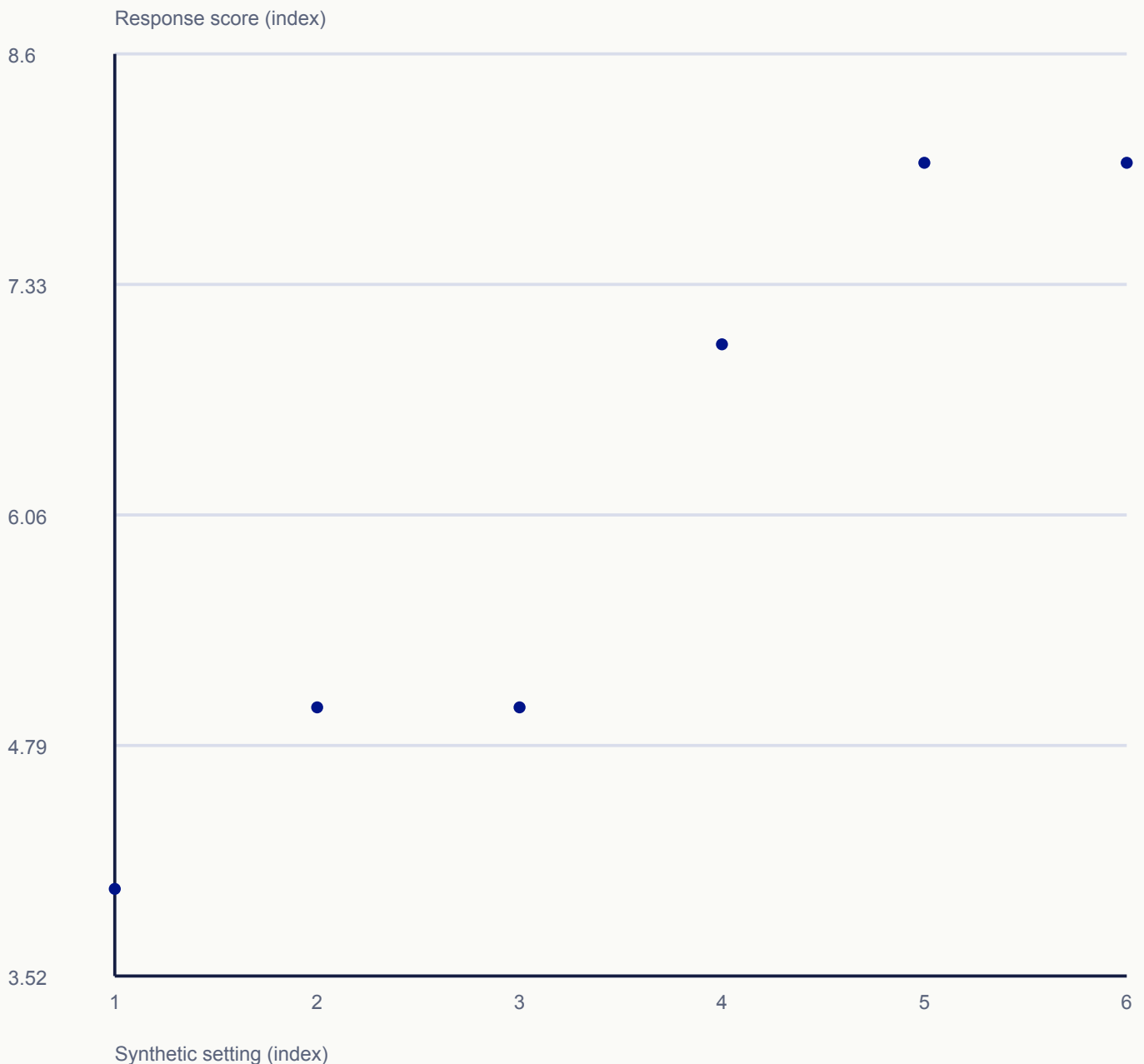
1. The fictional setting is not an equipment setpoint.
2. Six observational pairs cannot establish a safe intervention, causal effect or reliable prediction.

Fictional teaching case. Supplied observations support the exercise; proposed actions are not verified customer results.

See how the method works

A scatter plot preserves the pairing between two variables. Label both scales and make clear what one point represents. Pair observations from the same relevant unit or time window; arbitrary pairing can manufacture a pattern. An apparent slope is an invitation to investigate, not proof that changing one variable will change the other. Product mix, time, measurement error or an omitted factor may explain the relationship. Preserve source labels and inspect unusual points before fitting a model. A useful next step is a safe, discriminating test that would produce different predictions under the competing explanations.

Paired observations



Association only; no causal line or fitted prediction.

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Follow the evidence and decisions

Inspect the supplied case inputs

Observation	Setting index	Response score
1	1	4
2	2	5
3	3	5
4	4	7
5	5	8
6	6	8

01 / Define one paired observation

Ben identifies the record that links each setting index to its response score. He checks that no measurement has been matched to another observation merely because the columns were sorted.

Why: A scatter plot analyzes joint observations. Independently sorting columns can manufacture a positive relationship even when none existed in the actual records.

Evidence / check: Every plotted point retains an observation identity.

02 / Plot the supplied pairs honestly

He labels the horizontal axis synthetic setting index and the vertical axis response score. He plots all six pairs with no causal fitted line or real-machine units.

Why: The graphic should reveal the observations rather than create authority through an impressive trend line. A synthetic scale has no direct operating interpretation.

Evidence / check: The repeated scores at settings 2/3 and 5/6 remain visible.

03 / State the supported description

Ben describes an upward association in this small supplied set, with equal responses at some adjacent setting values. He does not say every increase produces an improvement.

Why: Association is a property of these observations. It is weaker than a causal or predictive claim and does not resolve the meaning or reliability of the response score.

Evidence / check: A written interpretation distinguishes the plotted pattern from an intervention claim.

04 / Name competing explanations

He asks whether observation order, a material change or a different operator moved with the setting. The record lacks those contextual fields, so the competing explanations remain open.

Why: A common influence can move both variables. Missing context should become an evidence request, not a convenient assumption that all other conditions were identical.

Evidence / check: The investigation record lists setting effect, order effect and source mix as hypotheses.

05 / Propose an authorized discriminating comparison

For the training exercise he sketches repeated comparisons with randomized order or an appropriate blocked design and consistent measurement. A qualified owner must approve any real experiment and operating range.

Why: An experiment needs a design that separates plausible influences and protects the process. This proposal is a reasoning exercise, not permission to alter equipment or choose a PID setting.

Evidence / check: The next step states what would be held comparable, what would vary and what outcome would challenge the hypothesis.

Completed association-to-test record

Evidence state	Observed or proposed statement	Allowed conclusion
Fact about supplied data	Pairs(1,4),(2,5),(3,5),(4,7),(5,8),(6,8)	Upward association in this set
Hypothesis	Setting may influence response	Needs discriminating evidence
Rival hypothesis	Order or source may affect both	Context not supplied
Next comparison	Approved repeated/blocked or randomized study	Design before intervention

One point was paired to the wrong record

The response 8 originally paired with setting 5 is found to belong to another observation.

Decision

Correct the source pairing with a traceable amendment and replot before interpreting. Retain the original mistaken version as an error record if required locally.

Reasoning

The strength or direction of association depends on correct pairs. A visually convenient point must not remain because it supports the preferred story.

What would change the decision?

The amended observation ID explains which point changed and why.

Practise with a changed case

A different scatter does not support the same story

New synthetic pairs are (1,6),(2,4),(3,7),(4,5). A presenter sorts responses into 4,5,6,7 while leaving settings 1,2,3,4 and claims a steady increase.

Setting	Actual paired response
1	6
2	4
3	7
4	5

Your task

1. Restore the correct paired points.
2. Explain exactly what the sorting operation changed.
3. Propose one contextual field and one next comparison before claiming cause.

Use the next page to record your reasoning before reading the answer.

Your practice worksheet

A different scatter does not support the same story

Observation pair

Actual plotted point

Unsupported claim

Rival explanation

Evidence needed

Complete your reasoning before turning to the answer. Use the separate learner workbook for group practice.

Check your reasoning and transfer it

1. The correct points remain(1,6),(2,4),(3,7),(4,5); they do not show a steady increase. Sorting the response column independently invented different observations.
2. Record time/order or source identity and design an authorized comparison that separates setting from that influence. No causal conclusion follows from correcting the graph alone.

Suggested completed record

Setting	Correct response	Sorted-column error
1	6	Would wrongly become 4
2	4	Would wrongly become 5
3	7	Would wrongly become 6
4	5	Would wrongly become 7

Plausible wrong turns

1. Association does not prove cause.
2. A fitted line cannot repair broken observation pairing.

Evidence of a sound answer

1. Retain all four exact pairs.
2. Identify the fabricated relationship.
3. State a testable rival explanation and authorized next evidence.

Take the learning back to work

Commitment	Agreed follow-through
Owner	Process analyst with an authorized experiment owner
Record	Paired source record, inference note and approved comparison plan
Review	Before any trial and after each reviewed result
Verification evidence	Pair integrity, controlled context and evidence that discriminates between explanations
If unresolved	Collect missing context or redesign the study rather than treating correlation as a command.

Help someone else apply the method

Prepare

1. Paired observation cards
2. Blank axes
3. Two colors for observed and hypothesized statements

Minutes	Activity and coaching prompt
4	Define a point What makes two values a pair?
8	Interpret the supplied graph Which sentence is supported and which is causal?
10	Expose the sorted-column error Compare actual and invented pairs.
5	Debrief the next test What design would separate setting from order?

Debrief

1. Reject safe-setting recommendations from synthetic indices.
2. Ask what result would weaken the preferred hypothesis.

Individual or remote practice

Plot the changed pairs by hand, then label each conclusion as observation, hypothesis or proposed test.

Connect the method and check its boundaries

Before application

1. Paired observations on a defensible basis
2. Defined units and source labels

Outside this lesson

1. Causal proof
2. Equipment settings or a validated prediction model

ASQ: Scatter diagram

ASQ: Scatter diagram

Plot paired numerical observations to examine association; an apparent relationship alone does not establish causation.

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