Study Guide — BI Problem 8: Independent Project (Mid-Project Test)

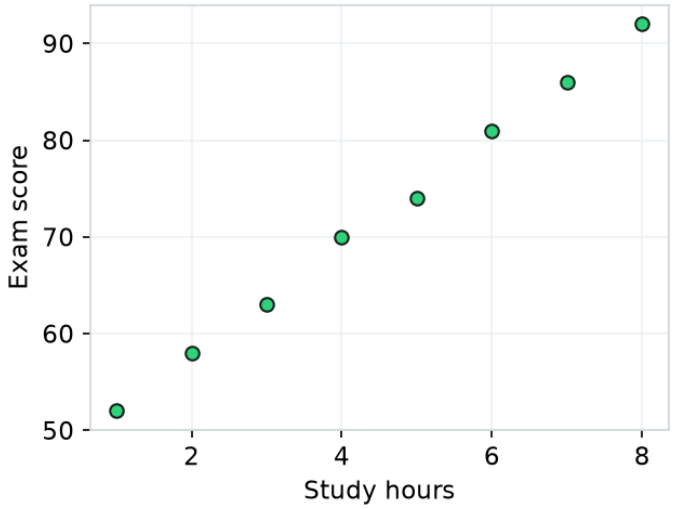
Biomedical Innovations · Problem 8 — Independent Project · Modeled on the PLTW Guided Review format

Vocabulary to know cold

Term	Definition
Operational definition	A precise, measurable definition of a variable (e.g., 'fever = temp above 38 C').
Placebo	An inactive treatment given to a control group to mimic the experience of the real treatment.
Double-blind study	A design in which neither participants nor assessors know group assignments, reducing bias.
Sampling bias	A systematic error from a sample that does not represent the whole population.
Accuracy	How close a measurement is to the true value.
Precision	How consistent repeated measurements are with each other.
Sensitivity	A test's ability to correctly identify true positives (people who have the condition).
Specificity	A test's ability to correctly identify true negatives (people who do not have the condition).
Assent	A minor's agreement to participate, given alongside guardian permission.
Confounding variable	An uncontrolled factor that affects the outcome and can be confused with the IV's effect.
Autoclave	A device that uses pressurized steam to sterilize equipment and decontaminate cultures.
Ultralow freezer	A -80 degrees C freezer used for long-term storage of biological samples.

Worked examples (follow the reasoning)

Example 1. A scatter plot shows steadily increasing exam scores as study hours increase. Describe the correlation and explain why you cannot claim causation.



- Read the trend: as the x-value (hours) rises, the y-value (score) rises consistently.
- Both variables move in the same direction, so this is a positive correlation, and the tight pattern makes it strong.
- Causation needs a controlled experiment; a correlation could be explained by a confounder such as motivation.
- So describe the association but do not claim that studying directly causes higher scores.

Answer: Strong positive correlation; causation cannot be claimed because confounding variables and the lack of a controlled experiment leave other explanations open.

Example 2. A group of darts all land tightly together in the upper-left corner, far from the bullseye. Is this precise, accurate, both, or neither? Explain.

- Check precision: the darts are tightly clustered, so the throws are repeatable, which means precise.
- Check accuracy: the cluster is far from the bullseye (true value), so it is not accurate.
- Therefore the result is precise but not accurate, which usually signals a systematic error.

Answer: Precise but not accurate; the consistent offset points to a systematic error that should be corrected.

Practice questions (with reasoning)

1. A researcher wants to remove their own expectations from how outcomes are scored. The best design choice is:

A. a larger font in the report
B. a double-blind protocol
C. fewer trials
D. a colorful poster

Answer: B. Double-blind protocols keep both subjects and assessors unaware of assignments, reducing observer bias.

2. Which sample is LEAST biased for estimating average height of all students?

A. Only the basketball team
B. A random sample drawn from the full roster
C. Only seniors
D. Only the front row of one class

Answer: B. A random sample of the whole population best represents it and reduces sampling bias.

3. A test misses many people who truly have a disease. The test has low:

A. specificity
B. sensitivity
C. precision of storage
D. sample size

Answer: B. Missing true cases (false negatives) reflects low sensitivity.

4. Before a flask of bacterial culture is thrown away, it should first be:

A. frozen at -80 C forever
B. autoclaved or disinfected to decontaminate it
C. left open on the bench
D. poured into the recycling

Answer: B. Cultures must be decontaminated by autoclaving or disinfectant before disposal.