



AP Statistics FRQ Practice · Unit 7

Quiz Scores Before and After Review Videos · numberbender.com

Name: _____

Date: _____

Score: / 4

What this question practices

- Recognizing paired data
- Carrying out a paired t test
- Constructing and interpreting a confidence interval for a mean difference
- Scope of inference without a control group

Show all your work. Answer each part in complete sentences, in the context of the problem. The data are hypothetical.
Suggested time: 13 minutes.

A teacher added short review videos to a unit. Ten students, selected at random from the teacher's 120 students, took a 50-point quiz on the unit before watching the videos and a similar quiz after watching them. Their scores are shown.

Student	1	2	3	4	5	6	7	8	9	10
Before	31	28	35	40	25	33	37	29	42	30
After	35	30	38	41	31	34	40	33	43	36

(a) Explain why a paired t procedure is appropriate here, rather than a two-sample t procedure.

(b) Do the data provide convincing evidence, at the $\alpha = 0.05$ level, that students' mean score increases after watching the review videos? Give appropriate statistical evidence.

(c) Construct and interpret a 95% confidence interval for the mean difference in scores (after – before).



(d) Can the teacher conclude that watching the review videos caused the increase in scores? Explain.





Each part is scored *E* (essentially correct), *P* (partially correct) or *I* (incorrect), the way AP readers score free-response questions. Compare your work with the model solution, then with the scoring note.

(a) Explain why a paired *t* procedure is appropriate here, rather than a two-sample *t* procedure.

- The same 10 students took both quizzes, so each before score is paired with an after score from the same student.
- The two sets of scores are not independent samples, so we analyze the differences (after – before).

Scoring. Essentially correct: says the same students were measured twice, so the data are paired or dependent.

(b) Do the data provide convincing evidence, at the $\alpha = 0.05$ level, that students' mean score increases after watching the review videos? Give appropriate statistical evidence.

- The differences (after – before) are 4, 2, 3, 1, 6, 1, 3, 4, 1, 6.
- H_0 : the mean difference is 0. H_a : the mean difference is greater than 0, where the mean difference is the true mean of (after – before) for all 120 of the teacher's students.
- Conditions: the 10 students were selected at random; 10 is less than 10% of the teacher's 120 students; and a dotplot of the differences shows no strong skew or outliers, so a *t* procedure is reasonable with $n = 10$.

$$\bar{x}_d = 3.1, \quad s_d \approx 1.912$$

$$t = \frac{3.1 - 0}{1.912/\sqrt{10}} \approx 5.13, \quad df = 9$$

$$P\text{-value} = P(t \geq 5.13) \approx 0.0003$$

- Because the P-value of about 0.0003 is less than 0.05, reject H_0 . There is convincing evidence that the mean quiz score for the teacher's students increases after watching the review videos.

Scoring. Essentially correct: hypotheses with a defined parameter, conditions (including a check of the differences for normality), correct mechanics, and a conclusion in context linked to the P-value.

(c) Construct and interpret a 95% confidence interval for the mean difference in scores (after – before).

- Use $t^* = 2.262$ for 95% confidence with $df = 9$.

$$3.1 \pm 2.262 \left(\frac{1.912}{\sqrt{10}} \right) = 3.1 \pm 1.37$$

$$(1.73, 4.47)$$

- We are 95% confident that the interval from 1.73 to 4.47 points captures the true mean increase in quiz score (after – before) for the teacher's students.

Scoring. Essentially correct: correct interval with work and an interpretation about the true mean difference, in context.



(d) Can the teacher conclude that watching the review videos caused the increase in scores? Explain.

→ No. This was not an experiment with a control group: every student watched the videos, and there was no random assignment of treatments.

→ The increase could be due to other things, such as practice from taking the first quiz or extra studying between quizzes.

Scoring. Essentially correct: says no, with a reason based on the lack of a control group or random assignment, and names a plausible alternative explanation.

