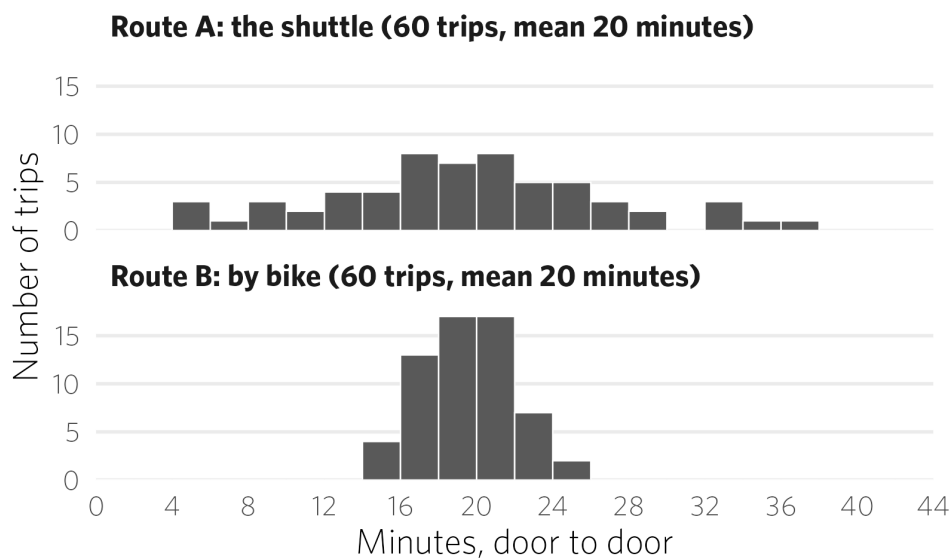


PSYCH 10 · Fall 2026 · Worksheet for Lecture 6: Quantifying error · Answer key

The answers are in blue. Where a question has more than one defensible answer, the key says so and describes what a good answer contains.

Part 1 · Two routes, one average



Two routes to campus. The histograms show 60 recorded trips on each; both routes have a mean of 20 minutes, door to door.

a. You have an exam at 1:30 and you leave at 1:05. Which route do you take, and why?

a. *Route B. Its slowest trip in the record is about 25 minutes, so leaving at 1:05 gets you there by 1:30 on every trip shown, while Route A has trips of over 30 minutes. The two routes have the same mean, so the mean alone can't make this choice, and the choice rests on the spread of the trips.*

b. Propose a number that measures how much more spread out Route A's trip times are than Route B's, and write down how you computed it.

b. *Any number that measures spread: the range (about 32 minutes for A against about 9 for B), the IQR, the average distance from the mean, the SD. A good answer shows the computation behind the number. If the number is "the average deviation from the mean," it comes out to zero for both routes, which is the lecture's next point.*

Part 2 · SS, variance, SD

Seven trips from each route, in minutes. **Route A: 8, 12, 17, 20, 23, 28, 32.** **Route B: 17, 18, 19, 20, 21, 22, 23.** Both sets have a mean of 20.

a. Route A's row of the table is filled in. Complete Route B's row.

	deviations	squared deviations	SS	variance	SD
Route A	-12, -8, -3, 0, +3, +8, +12	144, 64, 9, 0, 9, 64, 144	434	$434/6 = 72.3$	8.5 min
Route B	-3, -2, -1, 0, +1, +2, +3	9, 4, 1, 0, 1, 4, 9	28	$28/6 = 4.67$	2.16 min

b. For Route A, the mean absolute deviation (MAD) is 6.6 minutes and the SD is 8.5 minutes; for Route B, 1.7 and 2.2 minutes. On both routes the SD exceeds the MAD. In a sentence or two, explain which step in the computation of the SD makes it exceed the MAD.

b. *Squaring. Both measures start from the same seven distances from the mean: the MAD adds up the distances themselves,*

and the SD adds up their squares. Squaring makes the large deviations count for even more of the total. A deviation of 3 becomes 9, and a deviation of 12 becomes 144, so on Route A the two far trips are half of the MAD's total (24 of 46) but two thirds of the SD's total (288 of 434). The square root at the end puts the result back in minutes but does not undo the squaring, so the SD comes out larger than the MAD. Dividing by $n - 1$ rather than n adds a little more to the sample SD; an answer that names only this step has found a small part of the difference, since dividing Route B's SS by 7 instead of 6 still gives an SD of 2.0, above its MAD of 1.7.

c. Now consider a third set of seven trips, 10, 20, 20, 20, 20, 20, 30, which also has a mean of 20. For Route B, the SD (2.2) is only slightly larger than the MAD (1.7); for the third set, the SD (5.8) is twice the MAD (2.9). How does the arrangement of the third set's trips around the mean differ from Route B's, and why does that difference widen the gap between its SD and its MAD?

c. In the third set, five of the seven trips sit exactly at the mean of 20, and the other two, 10 and 30, are each 10 minutes from the mean. The MAD counts each of those two trips as 10; the SD counts each of them as 100, so the two far trips make up the whole of the SS. Route B's trips are spread evenly from 17 to 23, with no trip far from the mean, so its SD stays close to its MAD. The more of a set's spread that comes from a few far trips, the further the SD rises above the MAD. An answer that says only that the third set is more spread out has not answered the question: both its SD and its MAD are larger than Route B's, and the question is why its SD is twice its MAD.

d. Suppose every Route B trip had taken 5 minutes longer. Which of the mean, the SS, the variance, and the SD would change, and which would be unchanged?

d. Only the mean changes, to 25. Each trip moves up by 5 minutes and so does the mean, so every deviation is unchanged, and so are SS, the variance, and the SD.

e. A friend reports that on another route, the SD of 10 recorded trips is 4 minutes. What are the variance and the SS for those trips? Which of the three quantities is in minutes?

e. The variance is $4^2 = 16$ squared minutes, and SS is the variance times $n - 1$: $16 \times 9 = 144$ squared minutes. Only the SD is in minutes. An SS of 160 comes from multiplying by n rather than $n - 1$.

Part 3 • Using the mean and the SD

Route A's trips have a mean of 20 minutes and an SD of about 8.5 minutes; Route B's have a mean of 20 minutes and an SD of about 2.2 minutes.

a. You have an exam at 1:30 and want to arrive on time on almost every trip. State a rule for when to leave, in terms of the mean and the SD, and give the departure time it yields for each route.

a. Any rule stated in terms of the mean and the SD and applied to both routes. "The mean plus two SDs" gives 37 minutes on Route A (leave by 12:53) and about 24.5 minutes on Route B (leave by 1:05); "the mean plus one SD" gives 28.5 minutes on Route A (leave by 1:01) and 22 minutes on Route B (leave by 1:08). How many SDs of margin to allow depends on the cost of a late arrival.

b. Suppose the trip times had been recorded in seconds rather than minutes. For Route A, each of the mean, the SS, the variance, and the SD is multiplied by some factor. Give the four factors.

b. The mean and the SD are each multiplied by 60, since they are in the data's units; SS and the variance are multiplied by $60^2 = 3,600$, since they are in squared units.

c. One Route A trip took 32 minutes. How many SDs above the mean is that trip?

c. 12 minutes above the mean, and $12/8.5 \approx 1.4$ SDs above the mean.