Date 11-02-2026

Full name (in CAPITAL LETTERS) _____ **SUNet ID** (the part before @stanford.edu) _____ **Section** (e.g., TUES 9:30) _____

Please write legibly so the teaching team can log your attendance: if we can't read your name, we can't give you credit.

PSYCH 10 · Fall 2026 · Pre-practice exam

Question 1 · Two keyboard layouts

A typing course randomly assigned 10 of its students to practice for a week on one of two keyboard layouts, 5 per layout, and then measured each student's typing speed in words per minute (wpm). The R output follows.

```
favstats(~ WPM, data = typing)
 min Q1 median Q3 max mean       sd  n missing
  40 44     46 48  72   48 8.944272 10       0
favstats(WPM ~ Layout, data = typing)
    Layout min Q1 median Q3 max mean        sd n missing
1      New  44 46     48 50  72   52 11.401754 5       0
2 Standard  40 42     44 46  48   44  3.162278 5       0
```

The five New-layout students typed 44, 46, 48, 50 and 72 wpm; the five Standard-layout students typed 40, 42, 44, 46 and 48 wpm.

1.1 One fast typist

The New layout's standard deviation, 11.4 wpm, is more than three times the Standard layout's, 3.2 wpm, yet four of the New layout's five students typed within 6 wpm of one another (44, 46, 48 and 50). The deviations of the five New-layout students from the layout's mean of 52 are −8, −6, −4, −2 and +20.

(i) Which one student accounts for most of the New layout's SS, the sum of squared deviations from the mean? Give that student's typing speed in wpm. Say roughly what share of SS that student accounts for: about half, about three-quarters, or nearly all. Explain how you can tell; you do not need to compute SS exactly.

(i) That student's typing speed: _____ wpm

share of SS: ☐ about half ☐ about three-quarters ☐ nearly all Reason: _____

_____

_____

(ii) Suppose spread were measured with SAD, the sum of absolute deviations, instead. Would that student's share of SAD be larger or smaller than the same student's share of SS? Explain why, in terms of what squaring does to a large deviation.

(ii) Share of SAD compared with share of SS: ☐ larger ☐ smaller Reason: _____

_____

_____

1.2 Predicting with the median

A classmate says, "The 72 pulls the New layout's mean up, so a better model would predict each layout's *median* instead of its mean."

(i) For the New layout's five students, would predicting the median speed (48) for every student give a larger or a smaller total squared error than predicting the mean speed (52)? Say how you know; you do not need to compute either total.

(i) Total squared error with the median, compared with the mean: ☐ larger ☐ smaller Reason: _____

_____

_____

(ii) In what sense could the classmate's median be the better choice, and in what sense is the mean the better one?

(ii) _____

_____

_____

1.3 All ten students

The sum of squared deviations is 720 for all 10 students around their overall mean (48) and 520 for the New layout's five students around their mean (52). A classmate concludes, "So the 10 students' speeds are more spread out than the New layout's five."

(i) How well justified is the classmate's conclusion: well, partly, or not at all? Use the standard deviation of all 10 speeds and the standard deviation of the New layout's five speeds, both shown in the output.

(i) The classmate's conclusion is justified: ☐ well ☐ partly ☐ not at all Reason: _____

_____

_____

(ii) Explain how SS can be larger for the 10 students while their standard deviation is smaller.

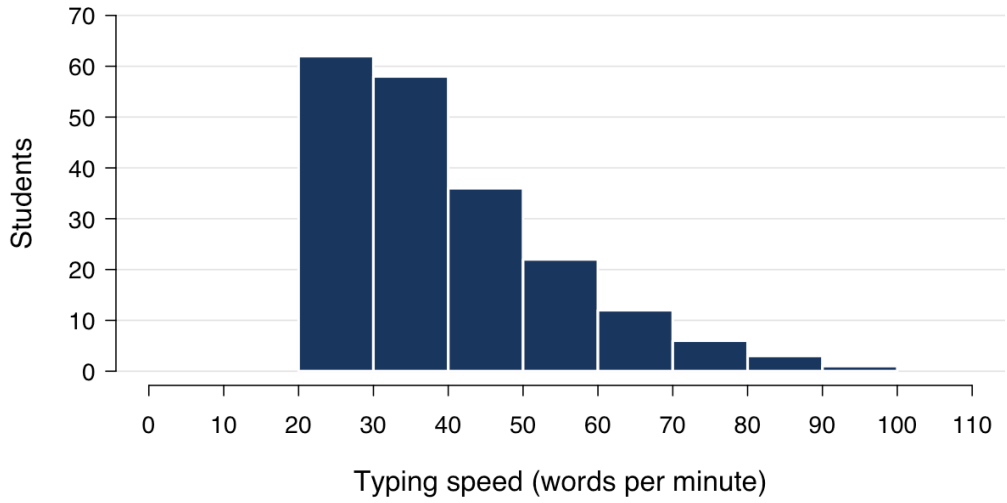
(ii) _____

_____

_____

1.4 The whole typing course

All 200 students in the course had their speed measured at the start of term. Their speeds have a mean of 40 wpm and a standard deviation of 15.3 wpm. Here is a histogram showing the distribution of typing speeds (words per minute) in this sample.

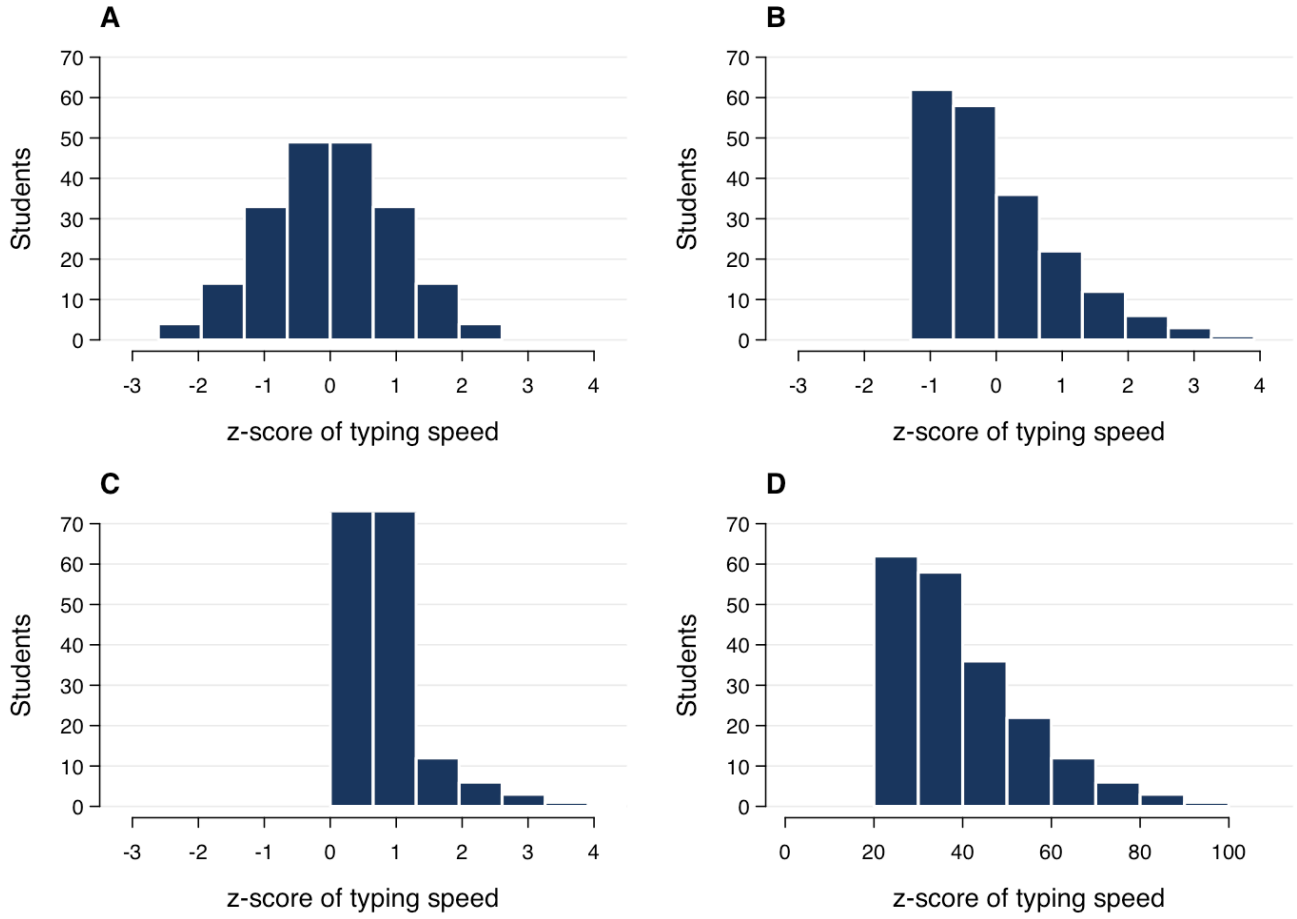


(i) The slowest student typed about 20 wpm and the fastest about 95 wpm. About how many standard deviations from the mean is each? A rough number is enough (for example, "about 1" or "between 3 and 4"). Which of the two speeds, 20 wpm or 95 wpm, is the more unusual?

(i) Slowest: about _____ SDs below the mean; fastest: about _____ SDs above the mean

More unusual: ☐ the slowest ☐ the fastest Reason: _____

(ii) Suppose all 200 speeds were converted to z-scores. Which of the four histograms below shows what you expect the histogram of the 200 z-scores to look like? Choose one, and give your reason.



(ii) ☐ A ☐ B ☐ C ☐ D Reason: _____

_____

_____

(iii) In a normal (bell-shaped) distribution, about 2.5% of values lie more than two standard deviations above the mean, and about 2.5% lie more than two standard deviations below the mean. For these speeds, two standard deviations above the mean is about 70 wpm, and two below is about 10 wpm. Use the histogram to judge whether each of those two percentages holds for these 200 students: is about 2.5% of the course above 70 wpm, and is about 2.5% below 10 wpm? Explain any difference.

(iii) _____

_____

_____

_____

Question 2 · Checking an AI assistant's ANOVA table

A company tested two versions of its checkout page. It randomly assigned 24 shoppers, 12 to each version, and timed how many seconds each shopper took to finish checking out. The company asked an AI assistant to analyze the data. Instead of showing R's output, the AI assistant wrote out the table and the summary below on its own. AI assistants can report numbers that look right but are wrong.

```
Model: Seconds ~ Page
             SS  df      MS      F     PRE
Model    44.000   1  44.000  4.000  0.6667
Error    88.000  23   4.000
Total   132.000  23
```

"Shoppers using the new page finished checking out faster on average than shoppers using the old page, and the page explains two-thirds of the variation in checkout time (PRE = .67)."

2.1 Which numbers don't add up?

Exactly three of the numbers in the table cannot be right, given the other numbers and the 24 shoppers. Use the relationships that tie the entries of an ANOVA table together (df, SS, MS, F and PRE) to find the three. For each, name the relationship it breaks and say what the number should be.

1. _____

_____

2. _____

_____

3. _____

_____

2.2 Time of day instead

The 24 shoppers came at four times of day, 6 at each. A designer fits `lm(Seconds ~ TimeOfDay)` to the same data and gets PRE = .40. The designer says, "Time of day explains 40% of the variation in checkout time, so it is the model to use." Compare it with the Page model, using the Page model's corrected PRE and F from 2.1.

(i) Would the time-of-day model's F be larger or smaller than the Page model's corrected F? Explain, using each model's PRE and the number of parameters each model uses (its df Model).

(i) Time-of-day F vs. Page F: ☐ larger ☐ smaller Reason: _____

_____

_____

_____

(ii) Which model gives the more convincing evidence that it explains real differences in checkout time, and why?

(ii) More convincing: ☐ the Page model ☐ the time-of-day model Reason: _____

Question 3 · The city's animal shelters

A city runs four animal shelters. The table gives the number of dogs each shelter placed in new homes in 2026 and the mean number of days those dogs waited before adoption.

Shelter	Dogs adopted	Mean wait (days)
North	200	19
South	50	40
East	30	50
West	20	70

3.1 The citywide mean

An analyst adds up the four means and divides by 4: (19 + 40 + 50 + 70) ÷ 4 ≈ 45. The report says, "The mean wait of an adopted dog in our city was 45 days."

(i) Each row of the table is one shelter. In the analyst's 45, does each shelter count equally, or does each dog count equally?

(i) Counts equally in the 45: ☐ each shelter ☐ each dog Reason: _____

(ii) North placed 200 of the 300 dogs, and those 200 dogs' mean wait was 19 days. Is the mean wait per dog closer to 19 days or to 45 days? Explain how you can tell; you do not need to compute the per-dog mean exactly.

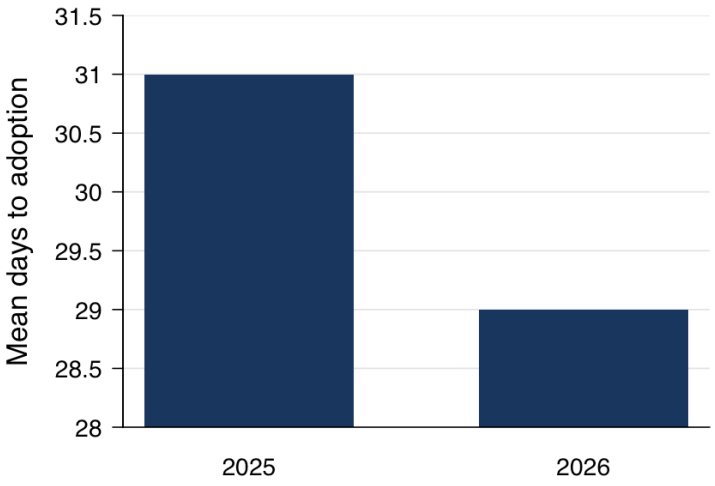
(ii) The mean wait per dog is closer to: ☐ 19 days ☐ 45 days Reason: _____

(iii) How well justified is the report's sentence? Rate it as well justified, partly justified, or not justified, and give the specific reason for your rating in one or two sentences.

(iii) The report's sentence is: ☐ well justified ☐ partly justified ☐ not justified Reason: _____

3.2 The director's slide

The shelters' director shows this chart at a city council meeting and says, "Wait times fell by about two-thirds in one year."



(i) What feature of the chart makes the drop look like two-thirds?

(i) _____

_____

(ii) Read the 2025 mean and the 2026 mean off the axis. By about how many days did the mean wait fall, and how does that drop compare with the two-thirds the director claims?

(ii) 2025 mean: _____ days; 2026 mean: _____ days; a drop of about _____ days

_____

(iii) Describe a chart of the 2025 and 2026 means that would not exaggerate the change.

(iii) _____

_____

Question 4 · Who uses the library?

A city wants to estimate what share of its adult residents used a public library in the past year.

4.1 The library's list

The library chose 500 people at random from its list of library-card holders and asked whether they had used a library in the past year. Of the 500, 58% said yes.

(i) As an estimate of the share of all adult residents who used a library in the past year, is 58% likely to be too high, too low, or about right? Explain how the way the sample was chosen affects the estimate.

(i) 58% is probably: ☐ too high ☐ too low ☐ about right Reason: _____

_____

(ii) How much would choosing 5,000 card holders at random instead improve the estimate of that share: a lot, a little, or not at all? Explain, and say how the sample would have to be chosen for the estimate to describe all adult residents.

(ii) 5,000 card holders would improve the estimate: ☐ a lot ☐ a little ☐ not at all Reason: _____

4.2 How far off?

The city then surveyed a random sample of 400 of all adult residents. The 400 residents' mean number of library visits in the past year was 9, with a standard deviation of 12 visits (many visited 0 times; a few visited more than 50 times). A planner says, "With a standard deviation of 12, our sample's mean of 9 could easily be off by 12 visits." Which response is best? Choose one, and give your reason.

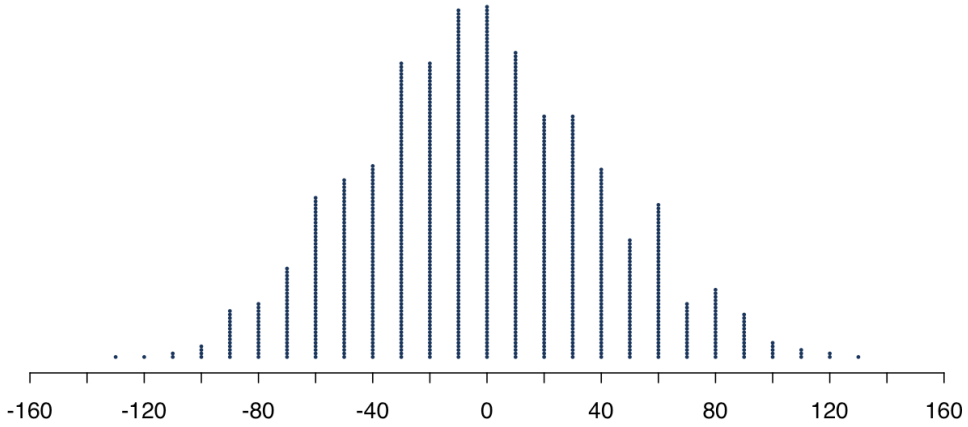
A. Agree: a sample's mean is usually off by about one standard deviation, which here is 12 visits.
B. Agree: many residents visited 0 times, so the data are too uneven for their mean to be a useful estimate.
C. Disagree: a mean of 400 residents varies far less than single residents vary, so the sample's mean is probably within a visit of the city's.
D. Disagree: because the sample was chosen at random, its mean equals the mean for all adult residents exactly.

☐ A ☐ B ☐ C ☐ D Reason: _____

Question 5 · Calorie counts on the menu

A restaurant randomly assigned each of 60 diners to one of two menus: 30 received a menu with the calories listed next to each dish, and 30 received the same menu without calories. The mean calories ordered were 90 lower with the calorie menu (796 against 886).

To judge this result, the researchers wrote each diner's calories ordered on a card, shuffled the 60 cards, dealt them into two piles of 30, called one pile "pretend calorie menu" and the other "pretend plain menu", and computed the difference between the two piles' mean calories (pretend calorie menu minus pretend plain menu). The researchers repeated this shuffle-and-deal 1,000 times. The plot shows the 1,000 differences, one dot per repetition.



5.1 What the shuffled differences show

Which statement best describes the 1,000 shuffled differences? Choose one, and give your reason.

A. The differences that chance alone would produce if the menu had no effect on diners' orders.
B. The differences that would be found if the study were repeated with 60 new diners.
C. The amount by which each diner's order would have changed with the other menu.
D. The differences that chance alone would produce if calorie labels cut orders by 90 calories.

☐ A ☐ B ☐ C ☐ D Reason: _____

_____

_____

5.2 Ninety calories

The researchers would have been just as interested if the calorie menu had *raised* orders by 90 calories.

(i) Use the plot to estimate roughly how many of the 1,000 shuffled differences are at least 90 calories from 0, in either direction (counting to the nearest 10 is fine), and say roughly what fraction of the 1,000 that is.

(i) Roughly _____ of the 1,000 shuffled differences, about 1 in _____

_____

(ii) State what that fraction says about the real result: how often chance alone would produce a difference of at least 90 calories if the menu had no effect, and whether the real result is strong or weak evidence that the calorie menu changed diners' orders.

(ii) _____

5.3 Twenty other things

Besides calories, the researchers compared the two groups on 20 other outcomes they had recorded, such as drinks ordered, desserts ordered, minutes at the table, and tip. Only one of the 20 comparisons, the tip, showed a difference of a size that came up in fewer than 5 of every 100 shuffled repetitions: diners with the calorie menu tipped more. A news story says, "Calorie labels make diners tip more!"

(i) How well justified is the news story's conclusion: well, partly, or not at all? Explain, in terms of the way the researchers arrived at the tip result.

(i) The conclusion is justified: ☐ well ☐ partly ☐ not at all Reason: _____

(ii) Write one or two sentences giving a fair report of the tip result.

(ii) _____

5.4 The second restaurant

A second restaurant repeats the study with 30 diners, 15 per menu. The mean calories ordered were 60 lower with the calorie menu. The researchers repeated the shuffling procedure on the new data: a difference of at least 60 calories from 0, in either direction, came up in about 27 of every 100 repetitions. A headline says, "Calorie labels don't work after all: study fails to replicate."

(i) How well does the second study's result agree with the first study's: fully, partly, or not at all? Compare the two differences in mean calories (their direction and size), and say what the 27 in 100 tells you about the second result on its own.

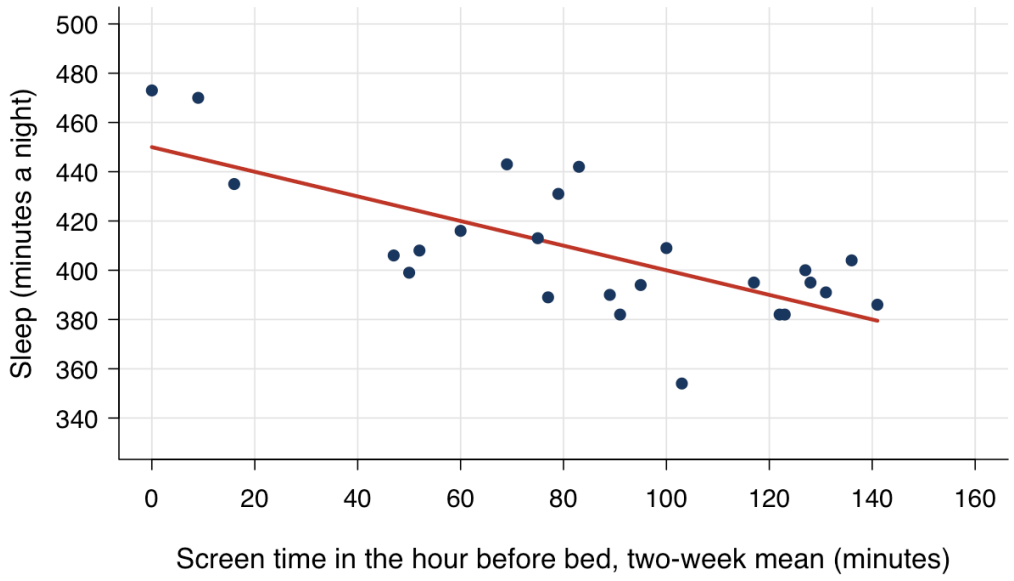
(i) Agrees with the first study: ☐ fully ☐ partly ☐ not at all Reason: _____

(ii) What does the second study, on its own, allow you to say about the size of the effect of calorie labels, if any? Then say how well the headline's conclusion is supported: well, partly, or not at all.

(ii) _____

Question 6 · Screens before bed

A sleep researcher asked 25 adults to record, every night for two weeks, the minutes they spent on screens in the hour before bed and the minutes they slept. In the plot, each dot is one adult's two-week means. The red line is the best-fitting straight line: predicted sleep = 450 − 0.5 × screen minutes.



6.1 Reading the line

(i) State in words, with units, what the −0.5 in the line's equation says about these 25 adults.

(i) _____

(ii) One adult's two-week means were 69 minutes of screen time and 443 minutes of sleep. Find this adult's dot in the plot. Is the adult's residual (actual sleep minus the line's predicted sleep) positive or negative, roughly how many minutes is it (reading from the plot is fine), and what does it say about this adult?

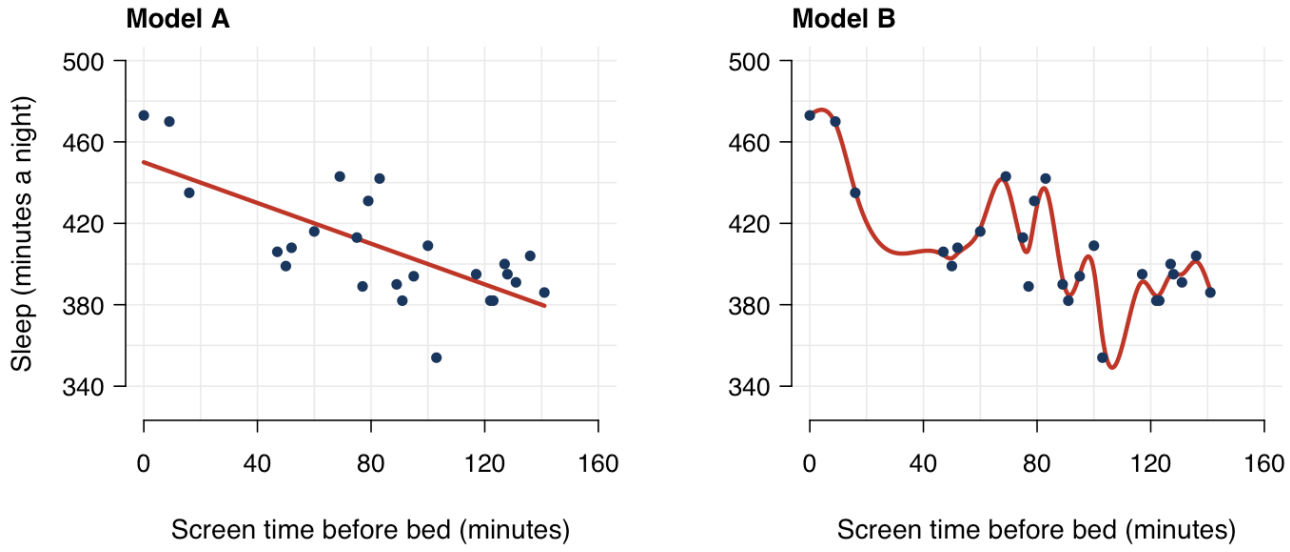
(ii) Residual: ☐ positive ☐ negative Reason: _____

roughly _____ minutes

What it says about this adult: _____

6.2 A curve through every point

A classmate fits Model B, a curve that bends to pass near almost every point. Its total squared error (the sum, over the 25 adults, of each adult's squared residual) is 863, against 9,167 for the straight line, Model A.



A new adult has a two-week mean of 105 minutes of screen time before bed.

(i) Read each model's predicted sleep for this adult from the figure, to the nearest 10 minutes.

(i) Model A predicts about _____ minutes; Model B predicts about _____ minutes

(ii) Say which prediction you trust more for this new adult, and explain why. Your explanation should say what the two models' total squared errors, 863 and 9,167, tell you about predictions for a new adult.

(ii) _____

_____

_____

_____

6.3 The headline

A news story about the study is headlined, "Screens before bed steal your sleep."

(i) The headline assumes that the causation runs in one direction. State that direction in one sentence.

(i) _____

(ii) Describe one specific process by which the pattern in the plot could arise even if screens do not shorten sleep.

(ii) _____

_____

_____

(iii) What does the possibility you described imply about what we can interpret from this analysis?

(iii) _____

_____

6.4 Testing the headline

Which study could show whether screen time before bed reduces sleep? Choose one, and give your reason.

A. Survey a random sample of 2,500 adults instead of 25 about their screen time before bed and their sleep.
B. Compare each adult's sleep on nights they chose to use screens before bed with their sleep on nights they chose to avoid screens.
C. Ask volunteers to choose whether to give up screens before bed for two weeks, and compare them with volunteers who keep their habits.
D. Randomly assign volunteers to avoid screens in the hour before bed or to feel free to use them, for two weeks; compare their sleep.

☐ A ☐ B ☐ C ☐ D Reason: _____

_____

_____