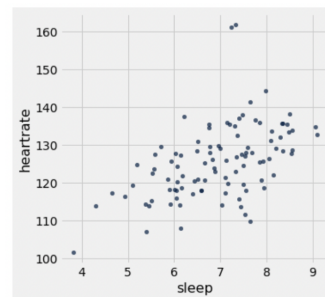1. You decide you want to see if there is a relationship between how much sleep a student in CSCI 3022 gets the night before the final exam and their average heart rate while taking the final exam in this class. You gather a random sample of data from students in CSCI 3022 and create the following scatterplot.

   Suppose you calculate the following from this sample data:
   - The heartrate data has an average of 125 beats per minute (bpm) and a standard deviation of 25 (bpm)
   - The sleep data has an average of 7 hours and a standard deviation of 0.5 hours
   - The correlation between the heartrate and and sleep data in this sample is 0.10

   

   (a) You decide to fit a Simple Linear Regression model to this sample data. Using the model, what is the predicted average heartrate for a student who gets 5 hours of sleep? Simplify your answer and show all steps justifying your work (an answer with no justification will receive no points).

   $$\frac{y-125}{25} = \frac{1}{10}\left(\frac{x-7}{1/2}\right), \quad y-125 = \frac{25}{10}\cdot\frac{2}{1}(x-7), \quad y-125 = 5x-35$$

   $$y(x) = 5x + 90, \quad y(5) = 5(5) + 90 = 115$$

   $$\Rightarrow y(5) = 115$$

   (b) You want to know whether there truly exists any linear relationship between hours of sleep and average heart rate during the final exam in the population of all CSCI 3022 students. You decide to conduct a hypothesis test at the significance level of 0.05. Which of the following statements below are the correct null and alternative hypotheses to conduct this test? Choose the correct letter and put in the corresponding boxes below.

   A. The **slope** of the regression line that predicts average heart rate from hours of sleep, computed using our **sample** of students is 5.

   B. The **intercept** of the regression line that predicts average heart rate from hours of sleep, computed using our **sample** of CSCI 3022 students is 0.

   C. The **slope** of the regression line that predicts average heart rate from hours of sleep, computed using our **sample** of CSCI 3022 students is 0.

   D. The **slope** of the regression line that predicts average heart rate from hours of sleep, computed using the **population** of all CSCI 3022 students is 0. Any difference in the slope of the regression line computed from our sample is just a result of chance.

   E. The **intercept** of the regression line that predicts average heart rate from hours of sleep, computed using the **population** of all CSCI 3022 students is 0. Any difference in the intercept of the regression line computed from our sample is just a result of chance.

   F. The **slope** of the regression line that predicts average heart rate from hours of sleep, computed using our **sample** of CSCI 3022 students, is not equal to zero.

   G. The **slope** of the regression line that predicts average heart rate from hours of sleep, computed using the **population** of CSCI 3022 students, is not equal to zero.

   H. The **intercept** of the regression line that predicts average heart rate from hours of sleep, computed using the **population** of CSCI 3022 students, is not equal to zero.

   Null Hypothesis (choose one letter)

   **D**

   Alternative Hypothesis (choose one letter)

   **G**

   (c) You use bootstrapping to calculate the 95% confidence interval for the true slope and your result is $[-1, 11]$. Which of the following conclusions can you make? Select all that apply.

   ☐ You can reject the null hypothesis.

   ☑ You fail to reject the null hypothesis.

   ☑ The data suggest that the association observed between heartrate & sleep could be due to chance alone.

   ☐ The data suggest that the association observed between heartrate and sleep is not due to chance alone.

   ☐ The data suggest that heartrate and sleep have no association.