8.9. The property "healthiness of a college lifestyle" is difficult to describe and hence difficult to measure. One poor way to measure this for a student would be to count the number of posters in his/her room. A more valid measurement might involve combining several aspects of health such as

- the number of calories consumed per day
- the number of hours of sleep each night
- the number of extra-curricular activities per month (academic and non-academic)
- the number of times the student engages in physical exercise per week
- the number of hours spent studying each day.

These variables (and possibly others) could be combined to form one overall measure of "healthiness." You will see I tried to make these variables well defined and specific so they are straightforward to measure.

8.12. This might be true if the classes had the same number of students in them. Otherwise, simply counting the number of F's is not a valid measure of instructor difficulty. For example, it could be the 8:30 section had 25 students in it, and the 1:30 section had 200 students! In this case, clearly the 8:30 instructor is tougher. A better way to compare the professors would be to use percentages instead; i.e., the percentage of students who received an F.

8.14. Here are the rates per million inhabitants, calculated as stated in the question. I ordered the states (from high to low) on the right of the table.

State	Rate (per million)	State	Rate (per million)
Alabama	12.5	Oklahoma	28.5
Arkansas	10.3	Texas	19.3
Delaware	16.6	Delaware	16.6
Florida	4.5	Alabama	12.5
Indiana	3.0	Arkansas	10.3
Nevada	4.0	Florida	4.5
Oklahoma	28.5	Nevada	4.0
Texas	19.3	Indiana	3.0

Here are some observations:

- Texas has the largest number of executions by far (545, a count). However, because their population is so large, they rank 2nd to Oklahoma when we adjust for population size (a rate).
- Delaware looks like it has just a few executions (16, a count), but they rate third highest when adjusting for population size. This is because the population of Delaware is small.

8.19. It might be the GATB score is not the best way to measure "readiness for employment," just as some believe a student's SAT score is not the best way to measure "readiness for college." However, it is possible to assess if GATB score has predictive validity of future job performance.

For example, here are some successful outcomes:

- positive first-year review
- job promotion
- employee awards.

We can assess whether GATB score is associated with a positive first-year review, whether a promotion was earned, and whether an employee was given an award. These variables are easy to measure.

8.24. (a) The first thing we want to do here is remember the conceptual representation of any quantitative measurement:

$$\text{Measured value} = \text{True value} + \text{Bias} + \text{Random error}.$$

The authors tell you to assume the bias is 0.1 inch. This means the subject always guesses 0.1 inch too large. We also know the true value is 2.9 inches. Our equation becomes:

$$\text{Measured value} = 2.9 + 0.1 + \text{Random error},$$

or, in other words,

$$\text{Measured value} = 3.0 + \text{Random error}.$$

Here are the four measured values (left-hand side) and the corresponding random errors (in **bold**):

$$\begin{aligned} 3.0 &= 3.0 + \mathbf{0.0} \\ 2.9 &= 3.0 + (-\mathbf{0.1}) \\ 3.1 &= 3.0 + \mathbf{0.1} \\ 3.0 &= 3.0 + \mathbf{0.0}. \end{aligned}$$

(b) We now want to calculate the variance of the four measured values: 3.0, 2.9, 3.1, and 3.0. We will follow the steps outlined in the notes:

Step 1: The average is

$$\frac{3.0 + 2.9 + 3.1 + 3.0}{4} = \frac{12.0}{4} = 3.0.$$

Step 2: Calculate each difference and square it:

$$\begin{array}{lcl} 3.0 - 3.0 = 0.0 & \Longrightarrow & (0.0)^2 = 0 \\ 2.9 - 3.0 = -0.1 & \Longrightarrow & (-0.1)^2 = 0.01 \\ 3.1 - 3.0 = 0.1 & \Longrightarrow & (0.1)^2 = 0.01 \\ 3.0 - 3.0 = 0.0 & \Longrightarrow & (0.0)^2 = 0. \end{array}$$

Step 3: Add up the squared differences:

$$0 + 0.01 + 0.01 + 0 = 0.02.$$

Step 4: Divide the sum by one less than the number of measurements:

$$\textbf{variance} = \frac{0.02}{3} \approx 0.0067.$$