Accurate Lab Readings

MATH TOPICS ADDRESSED:
- Finding the measures of center
- Deciding which measure of center is most appropriate
- Creating samples of known data
- Calculating percents in a given range
- Reasoning about a sensible answer under different conditions

Bart is a technician in a medical lab. It is important that his instruments provide him with accurate readings so that doctors can make an appropriate diagnosis based on his work. He has a new blood analyzing machine (BAM) and must establish quality-control ranges to determine the machine's accuracy. The manufacturer sends Bart two samples of blood containing known levels of glucose. Sample A is high at 230 mg/dL. Sample B is low at 70 mg/dL. Bart runs each sample through the BAM twenty times. The results are in the table below.

Trial	Sample A (mg/dL)	Sample B (mg/dL)
1	71	230
2	70	231
3	68	230
4	69	230
5	72	232
6	70	228
7	69	229
8	68	230
9	69	228
10	70	232
11	70	231
12	67	230
13	70	230
14	71	230
15	73	231
16	70	227
17	69	230
18	71	233
19	70	231
20	70	232

PROBLEMS

1. For each sample A and sample B, what is the mean for the glucose level measured for each sample? Round to two decimal places. What is the median for each?

2. Which would you choose for your analysis, the mean or the median? Why?

The data in the table show that the BAM gave slightly different readings for the same blood sample. Bart determines that if a reading is within 0.5 of the "true" value, 70, it is deemed acceptable. Use a random-number generator to pick two readings from each list.

3. Find the mean of these readings. As a class, see what percent of your sample means is within 69.5–70.5. How was this range determined?

4. Do the same procedure, but use four readings from each list. As a class, see what percent of your means is within 69.5–70.5.

5. If each test costs $2, would you prefer to have every tested blood sample run once, twice, or four times? Would more runs be preferable?

6. If each test costs $200, would you prefer to have every tested blood sample run once, twice, or four times? Would more runs be preferable?

Edited by **Erik Tillema**, etillema@iupui.edu, who teaches at Indiana University in Indianapolis. "Math for Real" highlights math concepts in the context of real-world problem solving. Readers are encouraged to submit ideas or work with someone to create a manuscript. Send to **mtms@nctm.org**.

The solutions are appended to the online version of "Math for Real" at **www.nctm.org/mtms**.

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SOLUTIONS, ONLINE ONLY

1. Sample A: Mean = 69.85, median = 70
   Sample B: Mean = 230.25, median = 230

2. The mean should be chosen. Since there are no outliers, this measure is okay. If students answer median, they must have a mathematically valid reason. Some students may prefer the median, as it gives the stated value from the lab as its result. Good discussion about measures of center and variability can result from this question.

3. Answers will vary. Be sure that each person uses different numbers from the set. Have students press a random number several times on a calculator to ensure that not all students are starting at the same point in the calculator's random number system. A table may be easier to use for random numbers.

4. Answers will vary. A higher percent should be within the range.

5. With the cost at only $2 per test, the more tests run, the better. However, time could be a factor. Four tests should result in over 95 percent correct, which is acceptable.

6. With the test cost being so high, the fewer trials run, the better. Students need to articulate what level of correctness they are willing to accept.

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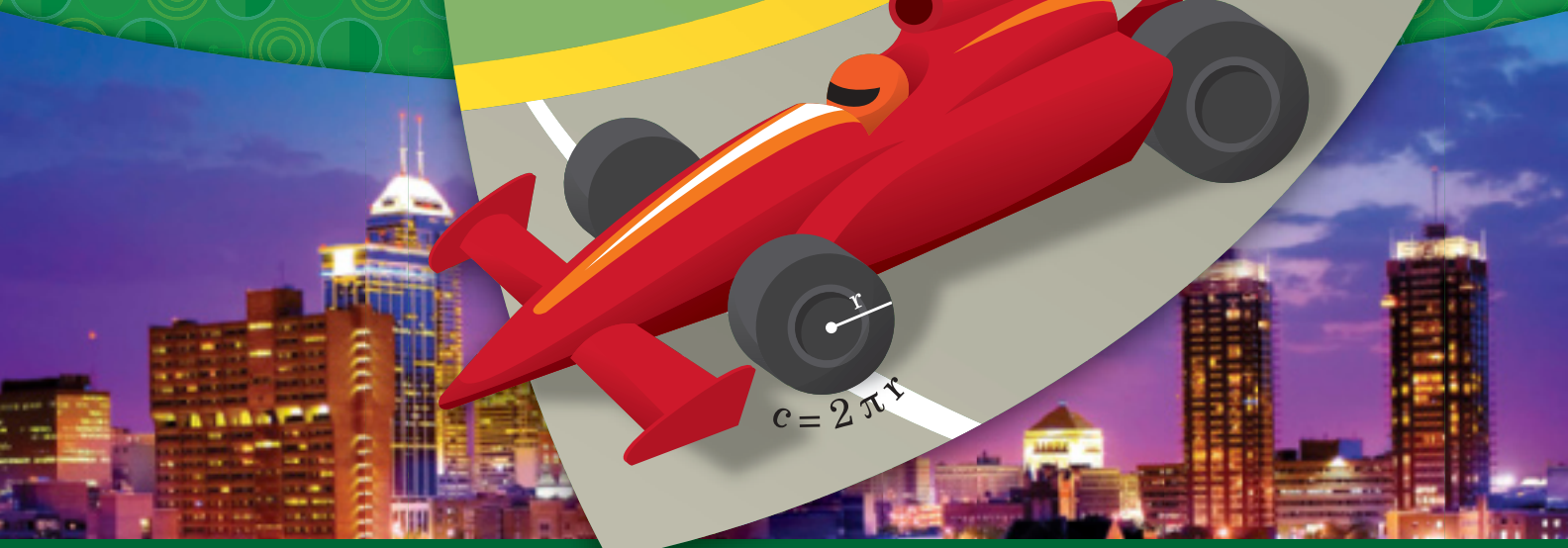

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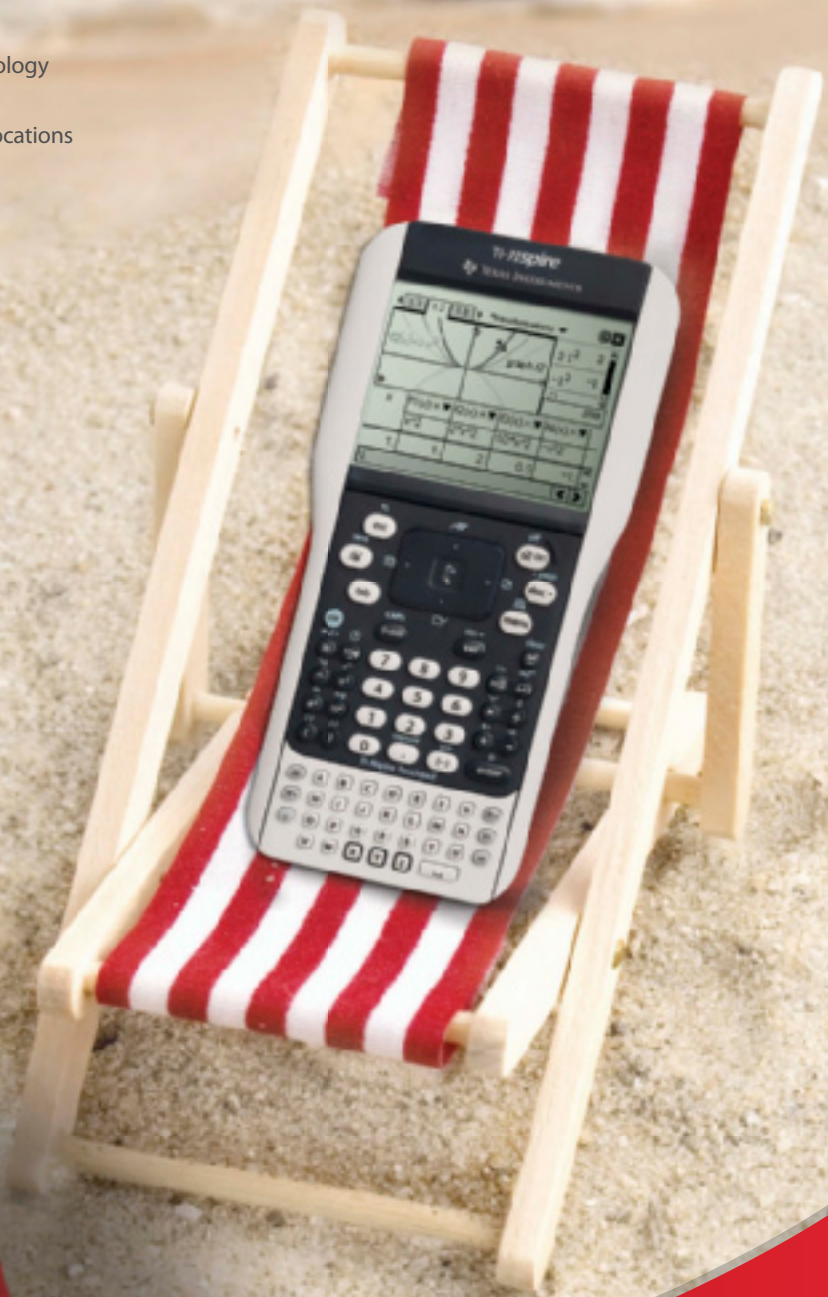

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