

Supplemental File

Select SSAC Module Survey Questions

Provided here are select SSAC module survey questions that are explicitly discussed in the paper.

The first 23 questions in the pre- and post-tests were the same for all modules. On the pre-test, these “core” questions were followed by five to 12 multiple choice and open-ended questions tailored towards testing quantitative skills and content within each module. These module-specific questions were repeated on the post-test, along with 10 additional “core” questions asking students about their impressions of the modules. All post-tests concluded with a question asking students to rank the difficulty of the modules completed thus far. *Italicized text provided after select questions are suggestions to improve clarity for future use.*

Core Questions

Of the “core” questions posed in all pre- and post-tests, the first set was designed to assess students’ comfort with Excel by providing a scenario and asking which method would the student use to solve the problem. For example:

1. One morning you count the number of birds on the Eckerd College seawall. You record 54 birds from 8 different species. How do you calculate the percentage of each species?
 - a. Calculator
 - b. Pencil & Paper
 - c. Spreadsheet Program (e.g., Excel)
 - d. Write your own computer program
 - e. Other – please specify _____

The next questions assessed students’ opinions about spreadsheets. For example:

1. I can use a spreadsheet comfortably to create graphs.
 - a. Strongly agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly disagree

The next core questions gauged Excel skills. The correct answers are indicated in boldface type. Select examples follow:

1. Which formula would you type into Excel to add 4 and 5?
 - a. =**4+5**

- b. $4+5=$
 - c. $4+5$
 - d. $E4+5$
 - e. Don't know.
2. How would you enter 0.0008 into an Excel formula in scientific notation?
- a. 8.00exp^{-4}
 - b. 8.00×10^4
 - c. **8.00E-4**
 - d. Don't know
3. What is the symbol to indicate an absolute cell reference?
- a. @
 - b. \$
 - c. #
 - d. &
 - e. Don't know
4. What is an absolute cell reference?
- a. It is the highest number in a series of cells
 - b. References to cells relative to the position of the formula.
 - c. It is the absolute value of a cell.
 - d. **References that always refer to cells in a specific location.**
 - e. Don't know
5. How would you add a trend line to a graph in Excel?
- a. Draw a line from the toolbar
 - b. **Right click on a data point and add a trend line, if using a PC.**
 - c. Trick question, you cannot add a trend line in Excel
 - d. Don't know

Module-specific Questions

Module specific questions were posed in each pre- and post-test to assess quantitative skills and content addressed in particular modules. Most questions are multiple-choice while a few are open-ended. Select examples are provided below.

Is it Hot in Here? C. Coolidge

1. How many inches are in three feet?
- a. 24 inches
 - b. 6 inches
 - c. 12 inches
 - d. **36 inches**
 - e. 44 inches

2. How many meters are in a megameter?
 - a. 1,000 meters
 - b. 10,000 meters
 - c. 100,000 meters
 - d. **1,000,000 meters**
 - e. 10,000,000 meters
3. What is the order of magnitude of 1.6×10^4 ?
 - a. 16,000
 - b. 0.006
 - c. 10.00
 - d. **4**
 - e. 1.6
4. How would you convert meters to kilometers?
 - a. **Divide by 1,000**
 - b. Multiply by 1,000
 - c. Multiply by 1×10^4
 - d. Divide by 10,000
 - e. Add 1,000
5. What is the equation to convert Fahrenheit to Celsius?
 - a. **$^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times (5/9)$**
 - b. $^{\circ}\text{C} = (^{\circ}\text{F}/32)$
 - c. $^{\circ}\text{C} = (^{\circ}\text{F} + 32)$
 - d. $^{\circ}\text{C} = ^{\circ}\text{F} \times 3$
 - e. None of the above
6. How many grams are in one pound?
 - a. 12 grams
 - b. 62 grams
 - c. **454 grams**
 - d. 1,000 grams
 - e. 1,022 grams
7. If there are 2,000 pounds in a ton, then how many tons is 1,000 pounds?
 - a. **0.5 tons**
 - b. 2 tons
 - c. 5 tons
 - d. 6 tons
 - e. 10 tons

Driving Across Town for Cheaper Gas, G. Franchy

1. How many minutes are in two hours?
 - a. 60 minutes
 - b. 100 minutes

- c. **120 minutes**
 - d. 160 minutes
 - e. None of the above
2. If you drive 6 miles at 60 mph, how long should it take you?
- a. **6 minutes**
 - b. 15 minutes
 - c. 10 minutes
 - d. 3 minutes
 - e. None of the above
3. What is the correct expression for miles per gallon?
- a. Miles multiplied by gallons
 - b. **Miles divided by gallons**
 - c. Gallons added to miles driven
 - d. Gallons divided by miles
 - e. None of the above
4. How would you calculate your net savings or loss for visiting a cheap gas station?
- a. Gross savings + miles per hour
 - b. **Gross savings – total cost of visit to gas station**
 - c. Gross savings – miles per gallon
 - d. Gross savings – cost of gas
 - e. None of the above
5. If an 8 pack of Pepsi bottles is on sale for \$2.40, what is the cost of an individual bottle of Pepsi?
- a. \$3.00
 - b. \$1.30
 - c. **\$0.30**
 - d. \$0.13
 - e. None of the above
6. If your car gets 24 mpg and gas costs \$3.00 per gallon, how much does it cost to travel one mile?
- a. \$8.00
 - b. \$3.00
 - c. **\$0.13**
 - d. \$0.08
 - e. \$0.03
7. Based on your answer to the previous question, where your car gets 24 mpg, if gas station A charges \$3.10 per gallon and gas station B, which is five miles farther away, charges \$3.00 per gallon, how much would you save by driving the extra distance? Assume there are no other factors involved in this problem.

- a. \$6.50
- b. \$3.00
- c. \$1.00
- d. **\$0.65**
- e. Don't know

Vacation! How Long and How Far? J. McIlrath

1. What is a guess?
 - a. **A prediction with little or no information.**
 - b. A rough calculation using simplified methods with approximations and assumptions.
 - c. Using exact calculations to achieve an answer
 - d. Don't know.
2. What is an estimate?
 - a. A prediction with little or no information.
 - b. **A rough calculation using simplified methods with approximations and assumptions.**
 - c. Using exact calculations to achieve an answer
 - d. Don't know.
3. How many centimeters are in one meter?
 - a. 0.10 cm
 - b. 1.0 cm
 - c. 10 cm
 - d. **100 cm**
 - e. 1000 cm
4. Suppose quizzes are 30% of your grade, tests are 40% of your grade, and the final exam is 30% of your grade. What method is used to calculate your grade?
 - a. Percent increase
 - b. Percent total
 - c. **Weighted average**
 - d. Weighted percent
 - e. Weighted total

Index Numbers: Gasoline and Inflation, S. Kiliç-Bahi

1. What does CPI stand for?
 - a. Consumer Product Inflation
 - b. **Consumer Price Index**
 - c. Customer Price Indication
 - d. Don't know

Illegal Software Installation, M. Allen

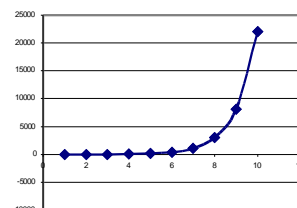
1. What is a rate?
 - a. Tool used in a yard
 - b. **Change in a value over time**
 - c. The amount of energy it takes someone to complete a task
 - d. Don't know

(In the future, I would change this question to "Which of the following is an example of a rate?" because answer (b), a change in a value over time, is an example of a rate, not an all-inclusive definition.)
2. What is an absolute quantity?
 - a. 12
 - b. A quantity that changes depending on what you compare it to
 - c. A quantity that stays the same regardless of what you compare it to
 - d. **Both A & C**
 - e. Don't know

(In the future, I would make 'c' the only correct answer, rewording the 'a' and 'd' answer selections:
a. A standard value that depends on sample size.
d. A quantity equal to the absolute value of a number.)
3. What is a relative quantity?
 - a. About 12
 - b. **A quantity that changes depending on what you compare it to**
 - c. A quantity that stays the same regardless of what you compare it to
 - d. Both A & B
 - e. Don't know
4. What is a pivot table? **Short answer question: An interactive summary of large datasets.**

What Time Did the Potato Die? R. Sunderman

1. What is the equation to convert Fahrenheit to Celsius?
 - a. $^{\circ}\text{C} = (^{\circ}\text{F} - 32) * (5/9)$
 - b. $^{\circ}\text{C} = (^{\circ}\text{F} / 32)$
 - c. $^{\circ}\text{C} = (^{\circ}\text{F} + 32)$
 - d. $^{\circ}\text{C} = ^{\circ}\text{F} * 3$
 - e. None of the above
2. As the value on the x-axis increases, the value on the y-axis does what?
 - a. **Increases**
 - b. Decreases
 - c. Stays the same



- d. Don't know
- 3. In the graph in the previous question, the change is...?
 - a. Linear
 - b. **Exponential**
 - c. Multivariate
 - d. Don't know

How Large is the Great Pyramid of Giza? H. L. Vacher

1. What is the equation for the volume of a pyramid?
 - a. **$(1/3)b \cdot h$**
 - b. $3/1h \cdot b$
 - c. $h \cdot b$
 - d. h/b
 - e. Don't know

(In the future, I would reformat the answer selections in this way:

 - a. **$V=(1/3)bh$**
 - b. $V=(3/1)bh$
 - c. $V=bh$
 - d. $V=b/h$
 - e. *Don't know*)
2. Given the volume, how do you find the cross-sectional area of a wall?
 - a. **Divide by the length**
 - b. Add the width
 - c. Multiply by the height
 - d. Divide by the density
 - e. Don't know
3. If 115,000 stones were laid out each year, and there are 365 days in one year, how many stones were laid out each day?
 - a. 545
 - b. 215
 - c. 145
 - d. **315**
 - e. Don't know
4. What is the volume of a pyramid with a base of 18 square feet and a height of 10 feet?
 - a. **60 cubic feet**
 - b. 55 cubic feet
 - c. 50 cubic feet
 - d. 45 cubic feet
 - e. Don't know

5. If there are 12 inches in a foot, how many inches are in 6 feet?
 - a. 2 inches
 - b. 12 inches
 - c. 36 inches
 - d. **72 inches**
 - e. Don't know

Earthquake Magnitude, L. Wetzel

1. The Richter Scale is
 - a. Linear
 - b. **Logarithmic**
 - c. Parabolic
 - d. Cubic
 - e. None of the above
2. $\log(10000)$ equals
 - a. **4.00**
 - b. 5.23
 - c. 24.87
 - d. Don't know
3. Which one of these represents a ratio?
 - a. $1/3$
 - b. 1:3
 - c. 1 to 3
 - d. **All of the above**
 - e. Don't know
4. What is this number in standard scientific notation? 6000
 - a. 10×6^3
 - b. $6^2 \times 10$
 - c. **6×10^3**
 - d. 5×10^5
 - e. Don't know
5. An increase from magnitude 6 to 7 on the Richter Scale corresponds to a
 - a. Linear increase in seismogram amplitude (e.g., from 10 to 20mm).
 - b. **10-fold increase in seismogram amplitude (e.g., from 10 to 100mm).**
 - c. ~30-fold increase in seismogram amplitude (e.g. from 10 to 300mm).
 - d. ~50-fold increase in seismogram amplitude (e.g. from 10 to 500mm).

Global Climate, P. Butler

1. How many significant figures are there in 5001?
 - a. 2
 - b. 3
 - c. **4**
 - d. 5
 - e. Don't Know
2. How many significant figures are in 1,100?
 - a. **2**
 - b. 3
 - c. 4
 - d. 5
 - e. Don't know
3. How many significant figures are in 0.008?
 - a. **1**
 - b. 2
 - c. 3
 - d. 4
 - e. Don't know
4. What is this equation used to find? $4\pi r^2$
 - a. **Surface area of a sphere**
 - b. Area of a pyramid
 - c. Base area of a rectangle
 - d. Hypotenuse of a right triangle
 - e. Don't know
5. What is the formula for the area of a circle?
 - a. $A=l*w$
 - b. $A=(1/2)b*h$
 - c. $A=2\pi r$
 - d. **$A=\pi r^2$**
 - e. Don't know

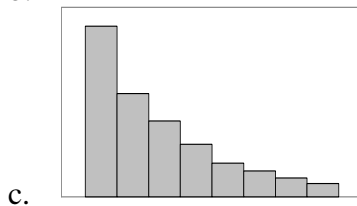
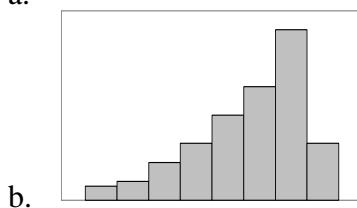
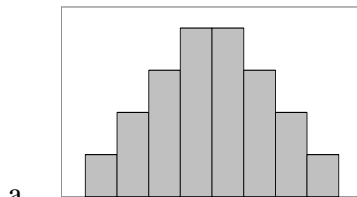
(For consistency, in the future I would omit the asterisks from the first two selections, making them " $A=lw$ " and " $A=(1/2)bh$ ", respectively.)
6. What is a guess?
 - a. **A prediction with little or no information.**
 - b. A rough calculation using simplified methods with approximations and assumptions.
 - c. Using exact calculations to achieve an answer
 - d. Don't know.

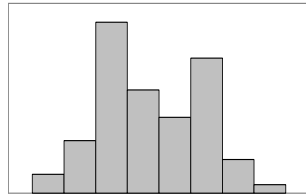
7. What is an estimate?
 - a. A prediction with little or no information.
 - b. **A rough calculation using simplified methods with approximations and assumptions.**
 - c. Using exact calculations to achieve an answer
 - d. Don't know.

Frequency of Large Earthquakes, H. L. Vacher

1. What is the mean of 1,2,3,3,3,4,5,6,7,8?
 - a. 4
 - b. **4.2**
 - c. 3
 - d. 3.5
 - e. Don't know
2. What is the median of 1,2,3,3,3,4,5,6,7,8?
 - a. 4
 - b. 4.2
 - c. 3
 - d. **3.5**
 - e. Don't know
3. What is the mode of 1,2,3,3,3,4,5,6,7,8?
 - a. 4
 - b. 4.2
 - c. **3**
 - d. 3.5
 - e. Don't know
4. Which of these lists has the highest standard deviation?
 - a. 1,2,3,4
 - b. 2,2,3,3
 - c. **1,1,4,4**
 - d. 1,2,4,4
 - e. Don't know
5. You have a bucket filled with sea shells, and they have a small size variance. What does this mean?
 - a. **They are relatively the same size.**
 - b. They are relatively different sizes, ranging from very small to huge.
 - c. Their size variance doesn't mean anything.
 - d. The average is small.
 - e. Don't know

6. If you have 50 cards and 10 of them are red, then what percent of the cards are red?
- a. 5%
 - b. 10%
 - c. **20%**
 - d. 30%
 - e. Don't know
7. If there are 100 people in your class, and you are in the 15th percentile. Where do you rank?
- a. You rank somewhere in-between positions 1 to 15
 - b. **You are 15th in the class**
 - c. Your grade in the class was 15%
 - d. Your quotient is 15
 - e. Don't Know
8. If you rank at the first quartile in a class of 100 people, where do you rank?
- a. 4
 - b. **25**
 - c. 50
 - d. 55
 - e. Don't know
9. Which of these graphs is most like a normal distribution?





- d.
- e. Don't know

Post-Test Core Questions

After the module-specific questions, all post-tests contained 10 additional “core” questions asking students about their impressions of the modules. For the first questions, students were provided with these options:

- a. Strongly agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly disagree
1. This module made me more comfortable with using spreadsheets.
 2. I would recommend using this module in college level classes.
 3. This module improved my Excel Skills.
 4. This module improved my math skills.
 5. This module was interesting.
 6. This module improved my understanding of _____.

(In each post-test, we inserted a content-specific statement such as “earthquake magnitude.”)

For the last questions in this section, students were offered slightly different options:

7. The module length was _____.
 - a. Too short
 - b. Short
 - c. Just right
 - d. Long
 - e. Too long
8. How difficult did you find this module?
 - a. Extremely Easy
 - b. Easy
 - c. About Right
 - d. Hard
 - e. Extremely Difficult

Additional QL Questions

All SSAC module student versions may be freely downloaded from the SERC website (serc.carleton.edu/sp/ssac/index.html). At the SERC website, educators may also request instructor's versions that include all Excel spreadsheets that students will construct in the course of doing the modules. At the end of each instructor's module there is a PowerPoint slide containing a pre-/post-test to assess quantitative skills addressed in the module. In our in class study, we used these questions to further assess the McIlrath and Vacher modules. In each case, students were allowed to use calculators, but not Excel. Each question was worth a maximum of two points, for a total score of 12 points for each quiz.

Instructions to Students: Answer all of the following questions to the best of your ability. By answering all of these questions, you will gain 10 points towards your lab/homework total. No points will be deducted for incorrect answers. These questions will be used to assess how well you learned from the exercise and will be used to improve it.

Questions for *Vacation!* J. McIlrath

1. What is the difference between a guess and an estimate?
From McIlrath's module, slide 3: A guess is a prediction with little or no information. An estimate is a rough calculation using simplified methods with approximations and assumptions.
2. How many days would it take to drive a circuit that connects Phoenix, the Grand Canyon, Zion National Park, and 12 other parks in the Colorado Plateau of Arizona and Utah?
From McIlrath's modules, slide 14: 9 days
3. How many meters are there in 300 inches?
300 inches = 7.62 meters
4. If your car's thermometer reads 33°C, what is the temperature in degrees Fahrenheit?
33°C = 91.4°F
5. If you drive 70 mph for 2.5 hours and then 30 mph for 15 minutes, what was your average speed?
Average speed = 66.4 mph (a weighted average problem)
6. In 1960, a geology textbook cost \$25. The revised edition now costs \$100. What is the percent increase in the price of the textbook?
Cost increase = 300%

Questions for *Earthquake Frequency*, H. L. Vacher

The following spreadsheet lists the number of earthquakes with magnitude 7 or larger in the ten-year period, 1970-1979:

1. What is the mean number of earthquakes per year?

Mean = 20.8

2. What is the median?

Median = 20.5

3. What is Q1, the first quartile?

Q1 = 18.25

4. What is the 90th percentile?

90th %ile = 25.4

5. Write out the cell equation that finds the range in the number of earthquakes per year.

=MAX(C3:C12)-MIN(C3:C12)

6. Write out the cell equation that finds the number of years in which there were 21 earthquakes.

=COUNTIF(C3:C12,21)

	B	C
2	Year	Number
3	1970	29
4	1971	23
5	1972	20
6	1973	16
7	1974	21
8	1975	21
9	1976	25
10	1977	16
11	1978	18
12	1979	19

In retrospect, this set of questions could be improved by adding data for 1980 (18 earthquakes), yielding a list of 11 numbers that would allow students to solve these problems without a calculator. After ranking the 11 numbers from largest to smallest, the median would then be the 6th number, the 90th percentile would be the 2nd number, and the 25th percentile (Q1) would be midway between the 3rd and 4th from the bottom. In reviewing these questions, it was also noted that the actual number of earthquakes with a magnitude of seven or larger in 1979 is 15, not 19 as presented here.