

Compound True/False questions

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Some of the questions used especially in Assignments in this course are what can be called “compound true/false” questions. Here we will explain the reasons for and benefits of using this form and give some advice on how to complete such a question.

True/False questions can be very useful when examining conceptual material. Students also can readily successfully enter the right answer when they know it; in contrast, students often experience difficulty successfully entering their correct answers for questions with numerical or text answers because of various answer syntax problems.

Students, however, generally do not like True/False questions when the grading matters, as it does in our Assignment problems. Obviously, the examiner cannot give the student multiple attempts at a True/False question if the answer is to be revealed after each attempt. So only a single attempt can be allowed. As a result, minor conceptual errors or errors of accidentally clicking the wrong answer cannot be corrected, and the frustration and stress levels with such questions are therefore high.

In our "compound True/False" question, the student has to answer multiple True/False questions, and has to get them all right. However, the student is given multiple attempts at the question. After an attempt, the student is told if their complete set of answers is correct, though if not, they are not told which specific answers are wrong. Hence, they can be given multiple attempts at such True/False questions.

Now, such a question could be regarded as harder because the student has to get everything right to get any marks. And for, say, six such questions, the chance of getting them all correct by random choice is small – 1 in $2^6 = 64$. If, however, we also tell the student that exactly 3 of the answers are True (and therefore that 3 are False), we significantly improve the chances. There are now only $6!/(3!3!) = 20$ correct possibilities (i.e., the number of ways of choosing 3 from 6, irrespective of order). However, the odds are effectively tilted much more in the student's favor than this ratio of 20 and 64 might suggest. Before even submitting the answer, the student can use the questions where the student is more secure in their answer to help them answer the others. Furthermore, to get the answer to the entire set wrong, the student has to make at least two errors - one of the student's True answers must in fact be False, and one of the False answers must be True. Hence the student has many additional error checking possibilities.

This approach also opens an important learning strategy for the student: When the student deduces or is told that their overall answer attempt is not correct, the student then has to confront some contradiction in their own mind, and resolving such contradictions is generally viewed as being a very successful learning approach - once such a contradiction is resolved by the student's own actions, the student tends to remember the result.

For example, we might ask the following question:

Select all the prime numbers in the following set of six numbers. (Note: three of these numbers are prime and three are not.)

- a) 17
- b) 644
- c) 49
- d) 193
- e) 239
- f) 91

You likely already know that 17 is prime, 644 is not prime (it is an even number), and 49 is not prime (it is 7 squared). Of the remaining three numbers, it will be easiest to check 91, which you will soon be able to verify is not prime. Hence you conclude, correctly, that the remaining two, 193 and 239, are both prime numbers. You could check your reasoning and calculations by directly verifying that both 193 and 239 are prime by trying to divide by all odd prime integers up to approximately the square root of each (i.e., 3, 5, 7, 11, 13)..

So, you select a), d) and e).

A good strategy for answering such an overall compound true/false question is to start with or emphasize the individual questions where the student is most secure in their answer, and use the overall required consistency to help suggest the answers for the others (which is essentially the strategy we used above).

Please also note the following two important points here about answering such questions:

- 1) The automatic grader here is not very sophisticated. This has two consequences:
 - a) It cannot currently give partial credit for the parts you do get right, unfortunately (sorry!), and
 - b) it does not itself enforce the right total number of "True" answers. That is, even if we tell you that only three answers are "True", the grader will let you select any number of "True" answers even though any number other than three is doomed to failure. So you have to make sure you only select three.
- 2) Do make a note of each set of answers you enter so that you don't enter that set again!