Goals

1. Identify and interpret the base (prevalence), sensitivity, and false positive rate information encountered in medical tests.
2. Estimate or calculate the probability that a person actually has the disease given a positive test result.
3. Communicate the numerical result from their calculation to a lay person, both verbally and in writing.
4. Describe the potential benefits and hazards of medical tests, and the concept that routine cancer screenings for healthy persons are NOT always a good idea.

Assessment Plan

1. At least 3 low-stake quizzes on medical testing will be given to assess students' skills. Students will receive feedback based on their answers. Students' progress over time will be documented.
2. The medical testing problem will be included in midterm and final exams. Percentage of students who answer correctly (and partially correctly) will be recorded.
3. A writing assignment will be given to assess students' cognition and attitudinal domain.
4. A pre- and post-survey of students' general beliefs about early detection will be conducted, followed by a discussion.

Quiz and Exam Problems

Example 1

The doctor gives you a blood test for a relative rare disease that strikes 0.1% of people like you. The test is accurate 99% of the time, for those who have the disease and those who do not. Your test comes back positive. What is the probability you actually have the disease?

(Note: The *New York Times* Education Life section invited educators to write a question they'd like to see on the SAT, and David Bressoud gave this one, which was printed on August 4, 2013.)

Example 2

Although PSA levels are indicative of cancer, the test is notoriously unreliable. The probability that a noncancerous man will have an elevated PSA level is approximately 0.135, increasing to approximately 0.268 if the man does have cancer. If, on the basis of other factors, a physician is 70 percent certain that a male has prostate cancer, what is the

conditional probability that he has the cancer given that the test indicated an elevated PSA level?

Scoring Guide

2	Calculations related to the problem are correct and lead to a successful completion of the problem.
1	Calculations related to the problem are attempted but either contain errors or are not complete enough to solve the problem.
0	Calculations given are not related to the problem, or no work is present.

Writing Assignment

There is a growing recognition among medical professionals that cancer screening is a double-edged sword. While some individuals may benefit from early detection, others may be falsely diagnosed and treated for cancer unnecessarily. To make good decisions about screening, the public needs to know its potential benefits and harms.

The following two paragraphs are taken from a study to test physicians' ability to interpret clinical laboratory results.

> *To diagnose colorectal cancer, the hemoccult test is conducted to detect occult blood in the stool. For symptom-free people over 50 years old who participate in screening using the hemoccult test, the following information is available.*
>
> *The probability that one of these people has colorectal cancer is 0.3 percent. If a person has colorectal cancer, the probability is 50 percent that he will have a positive hemoccult test. If a person does not have colorectal cancer, the probability is 3 percent that he will still have a positive hemoccult test. Imagine a person (over age 50, no symptoms) who has a positive hemoccult test in your screening. What is the probability that this person actually has colorectal cancer?*

Your assignment is to use this hemoccult test scenario as an example to communicate the nature of a medical test to a lay person. (Think of a family member or a friend who is not familiar with statistics.) You need to incorporate three elements in your essay:

1. Identify the base rate (or prevalence in medical literature), sensitivity (the percentage of individuals with a disease who are correctly classified as having the disease), and false positive rate in this case. Provide a brief and clear description of these terms using your own words.

2. Calculate the probability that this person actually has colorectal cancer given a positive test.

3. Based on your analysis, communicate your result to someone who thinks that routine cancer screening tests for healthy persons are always a good idea.

Your essay will be scored based on your (1) interpretation, (2) calculation, and (3) communication; see the attached rubric. But don't simply do what the rubric tells you to do. Be creative: up to 3 additional points are based on effort, originality, or insight.

Rubric (this is modified after QLAR)

	Achievement Level			
Competency	3	2	1	0
Interpretation *Ability to explain information presented in mathematical forms.*	Correctly identify all relevant information.	Correctly identify some, but not all, relevent information.	Some relavant information is identified, but none is correct.	No relavent information identifies.
Calculation	Calculations related to the problem are correct and lead to a successful completion of the problem.	Calculations related to the problem are attempted but either contain errors or are not complete enough to solve the problem.	Calculations related to the problem are attempted but contain errors and are not comlete enough to solve the problems.	Calculations given are not related to the problem, or no work is present.
Communication *Expressing quantitative evidence in support of the argument or purpose of the work.*	A correct and complete explanation is clearly presented.	A partially correct relevant explanation is present, but incomplete or poorly presented.	A relevant explanation is present, but is illogical, incorrect, or incoherent.	No explanation is provided.

General Beliefs about Early Detection

The following questions are taken from a study published in JAMA. Students' responses will be compared with those from the national survey.

In addition to their choices, students will be asked to give their reason, which will be a basis of class discussion.

If there was a kind of cancer for which nothing can be done, would you want to be tested to see if you have it?

   ○ No

   ○ Yes

Routine screening means testing healthy persons to find cancer before they have any symptoms. Do you think routine cancer screening tests for healthy persons are almost always a good idea?

   ○ No

   ○ Yes

Would you prefer a total-body CT scan or receiving $1000 in cash?

   ○ Total-body CT scanning

   ○ $1000