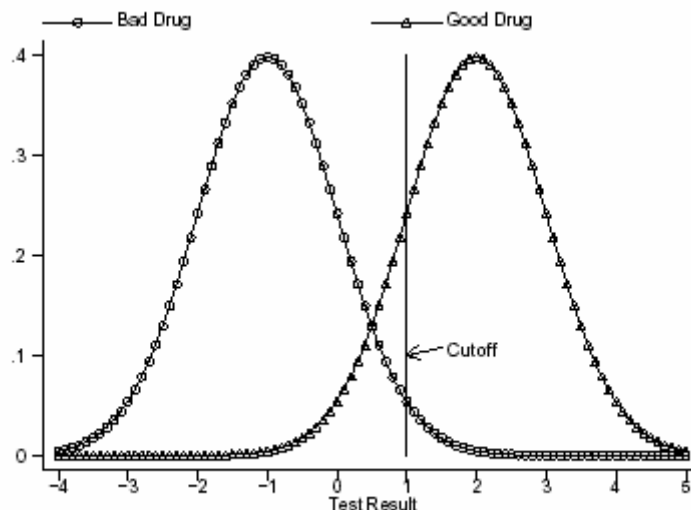


Problem Set 2**Problem #1: Problems from Phelps**

Phelps, Ch. 8—problems #1 and #4; Ch. 9—problem #2; Ch. 15—problem #3

Problem #2: Type I vs. Type II error

Consider the model of drug testing by the FDA that we discussed in class. A drug could be either good or bad and you have a test to help determine which kind of drug it is. Good drugs tend to yield high test scores, bad drugs low test scores. Unfortunately, this is not always the case. Here is the probability distribution of test scores for good and bad drugs. You set a threshold level of the test such that if the test yields a score above the threshold, you approve the drug, and not otherwise.



- (1) For a drug with the above distributions of test scores for good and bad drugs, plot the probability of a type I error (approving a bad drug) on the x-axis against the probability of a type II error (failing to approve a good drug) on the y-axis as the threshold approval level moves from -4 to 4. Getting the exact numbers right is not as important as getting the general shape right. (Incidentally, this graph you are making is known as a receiver-operator curve).
- (2) What will be the shape of the receiver-operator curve if there is no overlap in the distribution of test results for good drugs and bad drugs (that is, good drugs always yield a test result above some number, say x ; while bad drugs always yield test results below x)?
- (3) What will be the shape of the receiver-operator curve if the distribution of test results for good and bad drugs exactly overlap?

Problem #3: Medisure

It is the year 2005 and after graduating from Stanford, you have become the president of a small isolated island nation in the South Pacific. Your country has a health care system much like the one in the U.S., except much smaller. The government has a program “Medisure” designed to provide insurance for the old and the very old for free. Unlike the American Medicare system, the recipients of Medisure do not face any cost sharing – including premiums, deductibles, or copayments; that is, the elderly pay nothing. However, like Medicare, each young person pays \$1,000 in taxes into Medisure to support their elders (and like Medicare, they have no choice). Also like Medicare, there is a trust fund, currently with \$1 million dollars in it, which will reportedly go bankrupt any day now. At least, that’s what your political opponents say. You are up for re-election soon and have the unenviable task of saving Medisure.

Here is the current population of your island:

Age	Population
Young	100
Old	90
Very Old	50

Here are the yearly expenditures on medical care per person on your island:

Age	Expenditures
Young	\$0
Old	\$1,000
Very Old	\$4,000

There are some unique features about your island:

- There is full employment for every member of the young generation, no matter how high taxes get; All of them are able to pay the full \$1,000 for Medisure.
- Each year, the young become old, the old become very old, and all of the very old die. Here are the death rates in these life transitions:

Age	Death Rate
Young → Old	10.00%
Old → Very Old	44.44%
Very Old → Heaven	100%

- Your political life will last long enough that you will face the consequences of your decisions.
- Each year, there are 100 young people born.
- The trust fund earns no interest and there is no inflation.

In answering the following questions, it might be helpful to use a spreadsheet.

- (1) Are your political opponents right? That is, will the Medisure trust fund ever go bankrupt? If so, when?
- (2) As if things weren't bad enough, your scientists have come up with a breakthrough medical technology that will decrease death rates without affecting per-person medical costs for the elderly. The new death rates are:

Age	Death Rate
Young → Old	5.00%
Old → Very Old	36.84%
Very Old → Heaven	100%

Will the Medisure trust fund ever go bankrupt now? If so, when?

- (3) Appalled by the answer to the previous questions, you set your scientists to work again. They concoct another breakthrough technology that raises medical expenditures without having any effect on death rates. A truly remarkable achievement. Now you have lower death rates and higher medical expenditures. The new yearly medical expenditures per person are:

Age	Expenditures
Young	\$0
Old	\$1,500
Very Old	\$6,000

Will the Medisure trust fund ever go bankrupt now? If so, when?

- (4) Suppose the breakthroughs never happened so that the original death rates and schedule of yearly medical expenditures per person holds. Since your scientists are apparently no help, you decide that the right way to save Medisure is to raise the retirement age from old to very old. Now the old work and are taxed \$1,000 per person, just like the young, while consuming \$0 of Medisure health care (hopefully, they have other sources of insurance). Everything else stays the same.

Will the Medisure trust fund ever go bankrupt now? If so, when?

- (5) People (especially the old) hate your decision to raise the retirement age and they force you to lower it again. As a firm leader, you consider raising taxes to \$2,000 per year on each of the young. While this is bound to be unpopular in the short run, if you save Medisure, it might establish your legacy.

Will the Medisure trust fund ever go bankrupt now? If so, when?

- (6) Well, increasing taxes proved more unpopular than you could have imagined, and you were forced to lower them again to \$1,000 per year on each of the young. Ever resourceful, you hit upon another strategy – invest the trust fund in the stock market instead of those horrible Treasury bonds that earn no interest. You are confident that with the right investments, you can earn 10% per year on the trust fund.

Will the Medisure trust fund ever go bankrupt now? If so, when?

- (7) Alas, the stock market venture didn't work out quite as well as you might have liked – you earn 0% interest on the trust fund. You are truly desperate now, so you do the unthinkable. You allow 200 extra young workers to immigrate to your island and force them to pay the Medisure tax (thus making 300 young workers in total). To mitigate the political impact, you force them to leave your island before they become old and start using health care.

Will the Medisure trust fund ever go bankrupt now? If so, when?