Health Economics
Economics 156
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Problem Set 2 solutions

Problem #1: Problems from Phelps

Ch.8, problem #1:

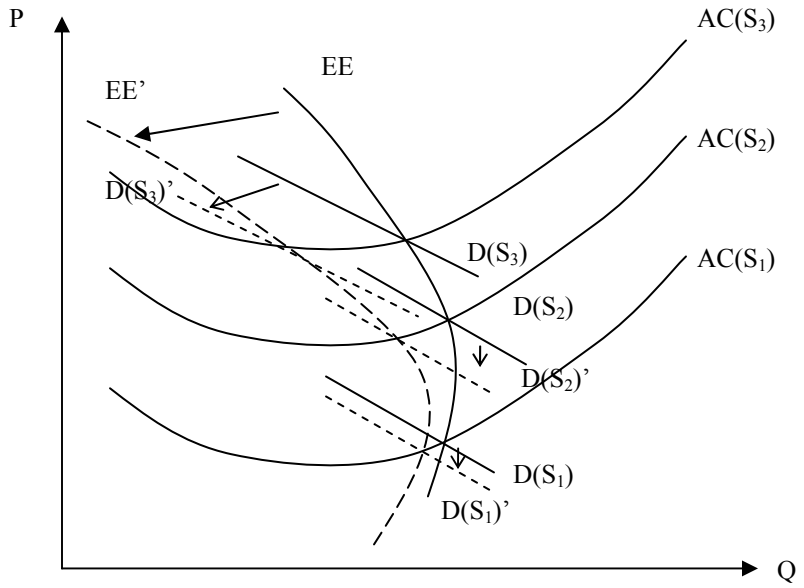
The main two distinguishing features of non-profits are that such firms cannot issue stock owned by people outside the company and that they are exempt from state and federal taxes. Profits earned must be disbursed within the company, rather than to outside shareholders.

Ch.8, problem #4:

(a) All else equal, I'd rather have open heart surgery in the larger hospital.
(b) See the answer in the back of the book!

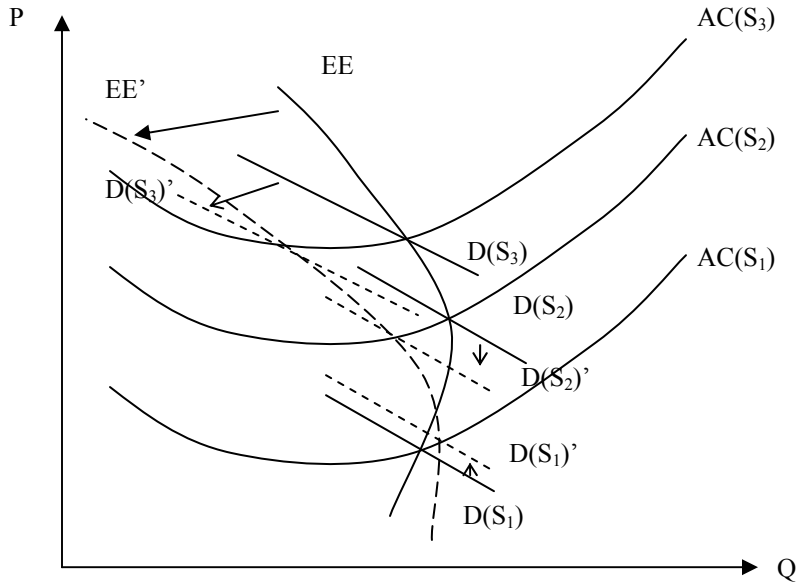
Ch.9, problem #2:

This is a difficult problem in part because the model of hospital competition in Phelps is not specified in a complete way (to do so would require concepts that are beyond the scope of the class). Mainly, I intended you to flesh out the discussion on p.293 in Phelps with graphs. In this discussion, the most important piece of information is the quality of the entering hospital. If the entering hospital is of higher quality than the monopolist hospital, then the demand curves for high quality care, say $D(S_3)$, will shift inward more than the demand curves for lower quality care, say $D(S_2)$ and $D(S_1)$.

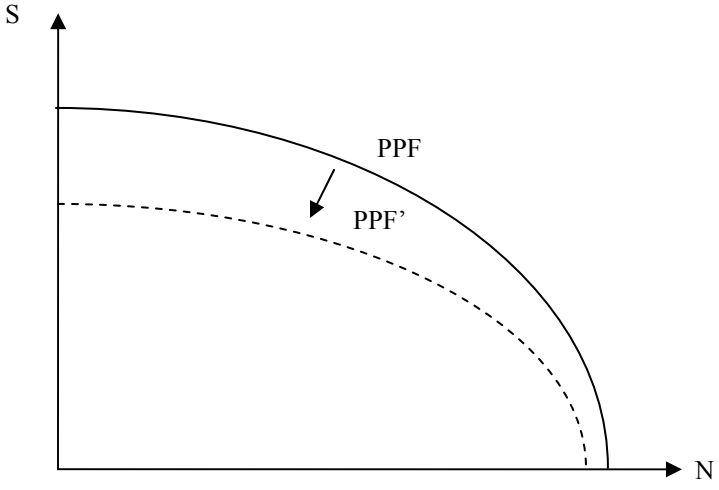


The EE curve is the locus of the intersections between the demand curves at different quality levels and the average cost curves, $AC(S_1)…AC(S_3)$. The new EE' curve is considerably flatter in its downward sloping section than is the original EE curve.

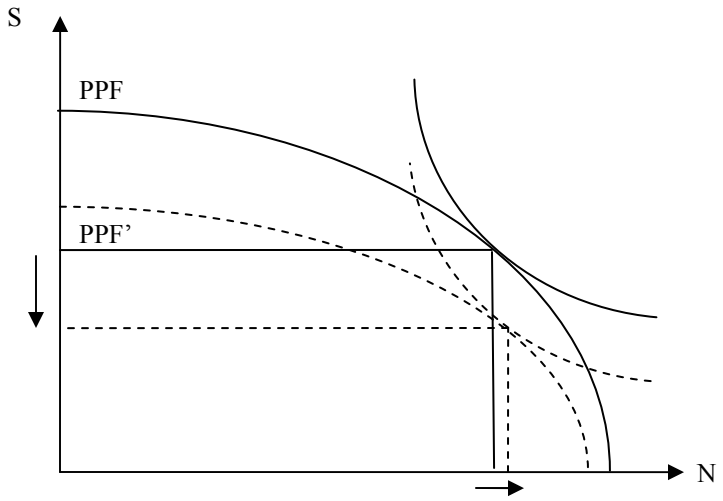
The discussion in Phelps hints that the demand for low quality care may actually increase in response to the entry by the new high quality hospital. While this seems unlikely to me, I suppose it is possible. In that case, $D(S_1)$ would shift out, rather than in and the graph would look like this:



In both cases, since the production possibility frontier (PPF) that the monopolist hospital faces derives from the downward sloping portion of the EE curve, entry by the high quality hospital will shift in the PPF more along the quality dimension (S) than along the number of patients (N) dimension.



Depending on the monopoly hospital's preferences, this would certainly lead to a decrease in quality at the monopolist hospital, and could either raise or lower the number of patients served. Drawn below is a case where the number of patients served increases.



The analogous analysis if a low quality hospital enters (rather than a high quality hospital) should be obvious. If an identical hospital enters, then all demand curves might shift in equally, leading to a parallel shift inward of the EE curve and of the PPF.

Ch. 15, Problem #3:
There are lots of sensible answers to this question. Here are some of the things on my list:

Potentially helpful effects of the FDA

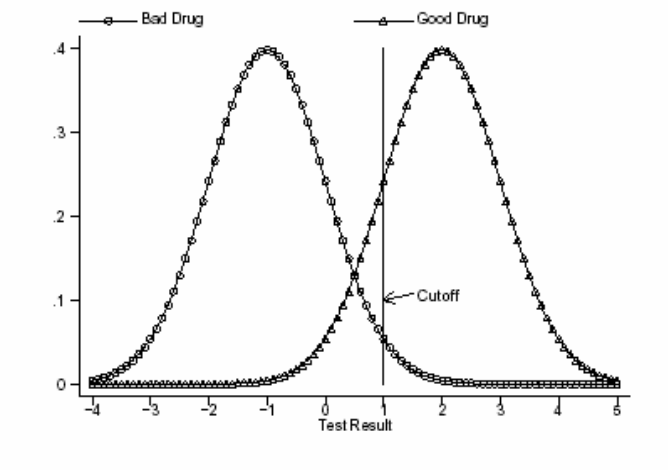
- Guarantee a rigorous process of vetting new drugs to guarantee (the extent this is possible) that the drugs are safe and effective.
- Make it more difficult for drug companies to advertise claims about their medicines that are unsupported by the scientific literature.
- Monitor drugs that are already on the market for adverse side effects.

Potentially harmful effects of the FDA

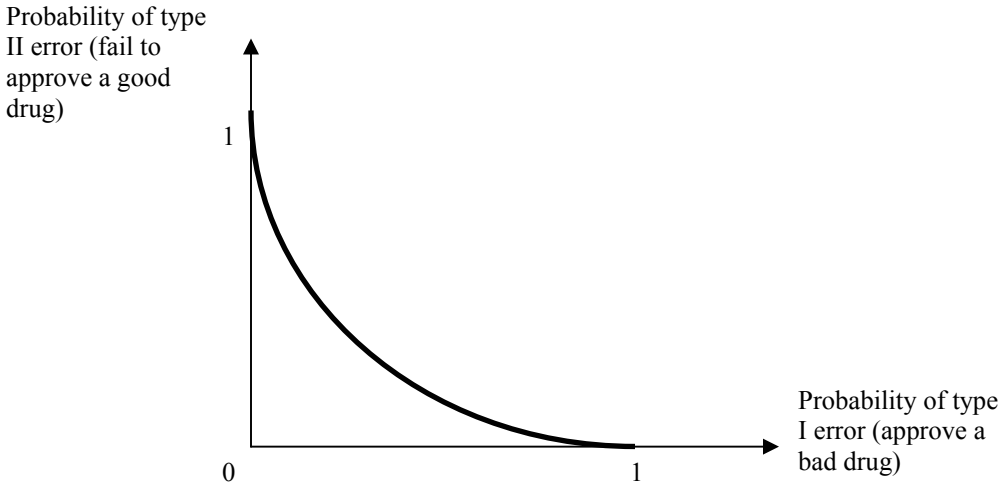
- Type I error: Allow a dangerous drug with adverse side effects on to the market.
- Type II error: Fail to approve a drug that is beneficial for some set of people.
- Delay the approval of beneficial drugs.
- Make the costs of drug research and development more costly.
- Shift R&D to other, less heavily regulated avenues (such as surgical techniques).
- Make it more difficult for new drug companies to enter the market.

Problem #2: Type I vs. Type II error

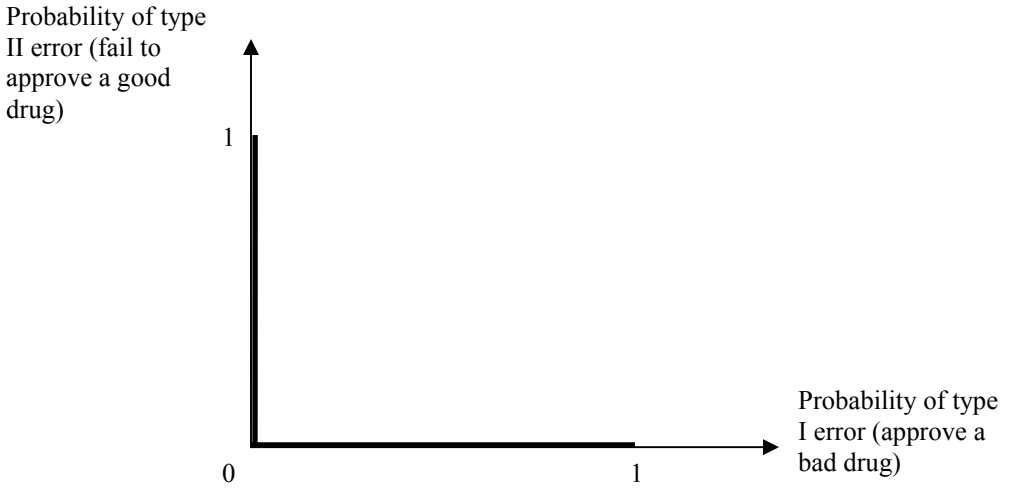
Consider the model of drug testing by the FDA that we discussed in class. A drug could be either good or bad and you have a test to help determine which kind of drug it is. Good drugs tend to yield high test scores, bad drugs low test scores. Unfortunately, this is not always the case. Here is the probability 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.



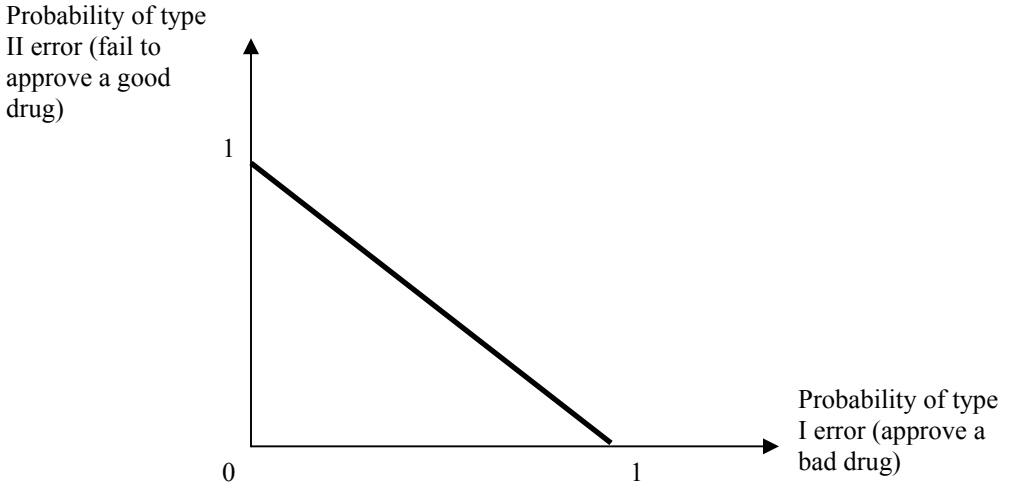
(1) For a drug with the above distributions of test scores for good and bad drugs, plot the probability of a type I error (approving a bad drug) on the x-axis against the probability of a type II error (failing to approve a good drug) on the y-axis as the threshold approval level moves from -4 to 4. 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?



Question (1): Are your political opponents right? That is, will the Medisure trust fund ever go bankrupt? If so, when?

	population			expenditures				
year	young	old	very old	young	old	very old	tot. expend.	fund at start of year
2005	100	90	50	-100000	90000	200000	190000	1000000
2006	100	90	50	-100000	90000	200000	190000	810000
2007	100	90	50	-100000	90000	200000	190000	620000
2008	100	90	50	-100000	90000	200000	190000	430000
2009	100	90	50	-100000	90000	200000	190000	240000
2010	100	90	50	-100000	90000	200000	190000	50000
2011	100	90	50	-100000	90000	200000	190000	-140000

Given the death rates, there is a stable population distribution, with $100,000 collected in taxes each year and $290,000 spent. The fund goes bankrupt sometime in 2010.

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

	population			expenditures				
year	young	old	very old	young	old	very old	tot. expend.	fund at start of year
2005	100	90	50	-100000	90000	200000	190000	1000000
2006	100	95	56.844	-100000	95000	227376	222376	810000
2007	100	95	60.002	-100000	95000	240008	235008	587624
2008	100	95	60.002	-100000	95000	240008	235008	352616
2009	100	95	60.002	-100000	95000	240008	235008	117608
2010	100	95	60.002	-100000	95000	240008	235008	-117400

Given these new death rates, it takes a couple of years to reach a stable population structure of 100 young, 95 old, and 60 very old. Given this stable population structure, you still collect $100,000 in Medisure taxes but expenditures increase to $335,008 per year. The fund goes bankrupt sometime in 2009.

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

	population			expenditures				
year	young	old	very old	young	old	very old	tot. expend.	fund at start of year
2005	100	90	50	-100000	135000	300000	335000	1000000
2006	100	95	56.844	-100000	142500	341064	383564	665000
2007	100	95	60.002	-100000	142500	360012	402512	281436
2008	100	95	60.002	-100000	142500	360012	402512	-121076

With the death rates of question (2), and the new medical cost structure, expenditures rise in steady state to $502,512 per year. The fund goes bankrupt sometime in 2007.

If you answered the question using the original death rates, you would have the following chart:

	population			expenditures				
year	young	old	very old	young	old	very old	tot. expend.	fund at start of year
2005	100	90	50	-100000	135000	300000	335000	1000000
2006	100	90	50	-100000	135000	300000	335000	665000
2007	100	90	50	-100000	135000	300000	335000	330000
2008	100	90	50	-100000	135000	300000	335000	-5000

In this case, the fund still goes bankrupt sometime in 2007 (though in a later month!).

Question (4): You decide that the right way to save Medisure is to raise the retirement age from old to very old.

	population			expenditures				
year	young	old	very old	young	old	very old	tot. expend.	fund at start of year
2005	100	90	50	-100000	-90000	200000	10000	1000000
2006	100	90	50	-100000	-90000	200000	10000	990000
2007	100	90	50	-100000	-90000	200000	10000	980000
…	…	…	…	…	…	…	…	…
2104	100	90	50	-100000	-90000	200000	10000	10000
2105	100	90	50	-100000	-90000	200000	10000	0

With the increase in the retirement age, the fund loses $10,000 per year. Since it starts with $1,000,000, it will take 100 years to go bankrupt, at the start of 2105.

Question (5): As a firm leader, you consider raising taxes to $2,000 per year on each of the young.

	population			expenditures				
year	young	old	very old	young	old	very old	tot. expend.	fund at start of year
2005	100	90	50	-200000	90000	200000	90000	1000000
2006	100	90	50	-200000	90000	200000	90000	910000
2007	100	90	50	-200000	90000	200000	90000	820000
2008	100	90	50	-200000	90000	200000	90000	730000
2009	100	90	50	-200000	90000	200000	90000	640000
2010	100	90	50	-200000	90000	200000	90000	550000
2011	100	90	50	-200000	90000	200000	90000	460000
2012	100	90	50	-200000	90000	200000	90000	370000
2013	100	90	50	-200000	90000	200000	90000	280000
2014	100	90	50	-200000	90000	200000	90000	190000
2015	100	90	50	-200000	90000	200000	90000	100000
2016	100	90	50	-200000	90000	200000	90000	10000
2017	100	90	50	-200000	90000	200000	90000	-80000

Even with the increased taxes on the young, you will still only be collecting $200,000 per year and spending $290,000. *The fund will go bankrupt sometime in 2016.*

Question (6): You invest the trust fund in the stock market instead of those horrible Treasury bonds that earn no interest.

There are several correct ways to answer this question that depend upon when during the year the interest on the trust fund accrues and when medical expenditures are paid out from the fund.

assumption #1: Interest accrues at the end of the year; expenditures occur in the middle of the year.

	population			expenditures						
year	young	old	very old	young	old	very old	tot. expend.	fund at start of year	fund at end of year	
2005	100	90	50	-100000	90000	200000	190000	1000000	810000	
2006	100	90	50	-100000	90000	200000	190000	891000	701000	
2007	100	90	50	-100000	90000	200000	190000	771100	581100	
2008	100	90	50	-100000	90000	200000	190000	639210	449210	
2009	100	90	50	-100000	90000	200000	190000	494131	304131	
2010	100	90	50	-100000	90000	200000	190000	334544.1	144544.1	
2011	100	90	50	-100000	90000	200000	190000	158998.51	-31001.49	

The fund goes bankrupt in 2011, despite the earned interest.

assumption #2: Interest accrues at the start of the year, expenditures occur in the middle of the year.

	population			expenditures						
year	young	old	very old	young	old	very old	tot. expend.	fund b/f start of year	interest earned	fund after spending
2005	100	90	50	-100000	90000	200000	190000	1000000	100000	910000
2006	100	90	50	-100000	90000	200000	190000	910000	91000	811000
2007	100	90	50	-100000	90000	200000	190000	811000	81100	702100
2008	100	90	50	-100000	90000	200000	190000	702100	70210	582310
2009	100	90	50	-100000	90000	200000	190000	582310	58231	450541
2010	100	90	50	-100000	90000	200000	190000	450541	45054.1	305595.1
2011	100	90	50	-100000	90000	200000	190000	305595.1	30559.51	146154.6
2012	100	90	50	-100000	90000	200000	190000	146154.61	14615.461	-29229.9
2013	100	90	50	-100000	90000	200000	190000	-29229.929	-2922.9929	-222153

Under this set of accrual assumptions, the fund goes bankrupt in 2012.

Other acceptable assumptions include continuous accrual of interest and steady expenditures throughout the year.

Question (7): . You allow 200 extra young workers to immigrate to your island and force them to pay the Medisure tax.

This question can be answered in two ways: you can assume that the immigration occurs once (in 2005),
or you can assume that the immigration occurs each year.
If the "immigration" occurs only in 2005, then the following chart holds:

	population				expenditures					
year	immig.	young	old	very old	immigrant	young	old	very old	tot. expend.	fund at start of year
2005	200	100	90	50	-200000	-100000	90000	200000	-10000	1000000
2006	0	100	90	50	0	-100000	90000	200000	190000	1010000
2007	0	100	90	50	0	-100000	90000	200000	190000	820000
2008	0	100	90	50	0	-100000	90000	200000	190000	630000
2009	0	100	90	50	0	-100000	90000	200000	190000	440000
2010	0	100	90	50	0	-100000	90000	200000	190000	250000
2011	0	100	90	50	0	-100000	90000	200000	190000	60000
2012	0	100	90	50	0	-100000	90000	200000	190000	-130000
2013	0	100	90	50	0	-100000	90000	200000	190000	-320000

The fund goes bankrupt sometime in 2011.

If immigration is allowed each year, then the following chart holds:

	population				expenditures					
year	immig.	young	old	very old	immigrant	young	old	very old	tot. expend.	fund at start of year
2005	200	100	90	50	-200000	-100000	90000	200000	-10000	1000000
2006	200	100	90	50	-200000	-100000	90000	200000	-10000	1010000
2007	200	100	90	50	-200000	-100000	90000	200000	-10000	1020000
2008	200	100	90	50	-200000	-100000	90000	200000	-10000	1030000
2009	200	100	90	50	-200000	-100000	90000	200000	-10000	1040000
…	…	…	…	…	…	…	…	…	…	…

The fund gains $10,000 each year and never goes bankrupt!