Ch 8: The Demand and Supply of Health Insurance

I. The Demand for Insurance

1. The Economics of Risk and Insurance
Why do we buy insurance? On average we pay more in premiums than we receive in benefits
Why do people buy lottery tickets? For every $1 you bet, you receive back $.50

The fact that the outcomes of some events are uncertain, cause us to change our standard utility theory.

First we will talk about the problem in general and then will apply it to the health care market.

Example 1:
Suppose you have a choice:
1) 10,000 for sure
2) I flip a coin:
    H=25,000
    T= -5,000
EV(1) = 10,000
EV(2) = .5(25,000) + .5(-5000) = 12500 + -2500 =10,000

What if changed 2 to
    H=40,000
    T= -5,000
EV(2) = 17500

What if changed to
    H= 50,000
    T= -5,000
EV(2) = 22500

Now what if :
    H = 10000
    T = -5,000

EV(2) = 47,500

What if:
    H = 1,000,000
    T = -5,000
EV(2) = 497,500

Note that if expected value was what was driving our decisions, everyone should have been indifferent to the first gamble, and jumped on number two for all the others. So obviously we do not try to maximize our expected value. What do we do then?

Expected Utility
Rational decision makers will choose the course of action that has the highest expected utility

The vonNeumann - Morgenstern utility function shows the decision makers preferences w.r.t. risk. Indicates how we convert wealth into utility, accounting for different states of the world. When deciding which of the above gambles to take (1 or 2) we compare:

$EU(2) = .5U(40{,}000) + .5U(-5{,}000)$

$EU(1) = U(10{,}000)$.

This approach allows an unequal weighting of outcomes: a loss of 5,000 may be more undesirable than a gain of 40,000 is desirable.

Suppose $U(x) = \sqrt{x}$ if $x > 0$ and $-\sqrt{|x|}$ if $x < 0$ where x is wealth, and wealth from all other sources =0.

So now:

$EU(1) = \sqrt{10{,}000} = 100$

$EU(2) = .5\sqrt{40{,}000} - .5\sqrt{5{,}000} = 100-35.36 = 64.64$

Thus this person would prefer the sure thing to the risk even though the expected value of the gamble is greater than the expected value of the sure thing.

Now suppose Pete's utility function is $U(x) = x^2$ if $x>0$ and $-x^2$ if $x<0$

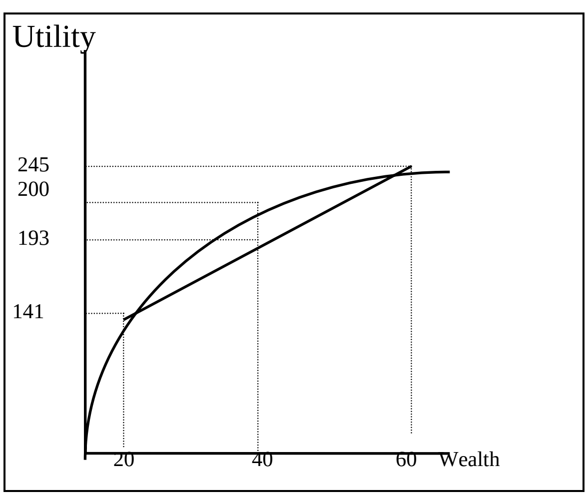
$EU(1) = 10{,}000^2 = 100$million

$EU(2) = .5(40{,}000^2) - .5(5{,}000^2) = 800m - 12.5m = 787.5m$ So Pete would flip the coin

What sets these two individuals apart?

Risk lovers vs. Risk averters>

A *Risk Averse* Utility Function:



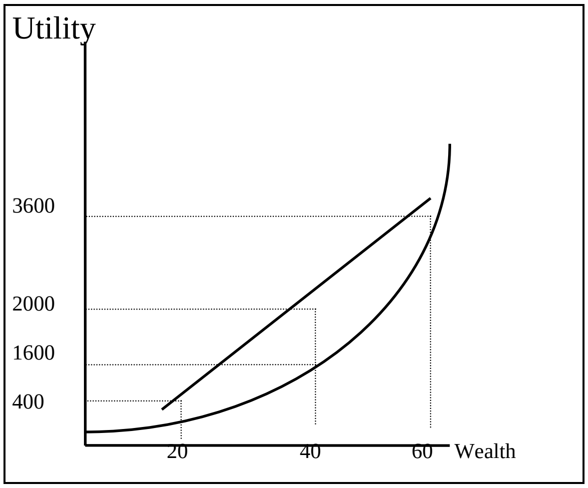
For a Risk Averse person utility increases in wealth but at a decreasing rate : diminishing MU of income.

Suppose we are choosing between 2 jobs:

1) 40,000 for sure
2) .5 *20,000 or .5*60,000

The expected value is 40,000 for both, but EU(1)=200 while EU(2)=193. So the risk averse person would choose 1. **That is a risk averse person would turn down a fair bet.**

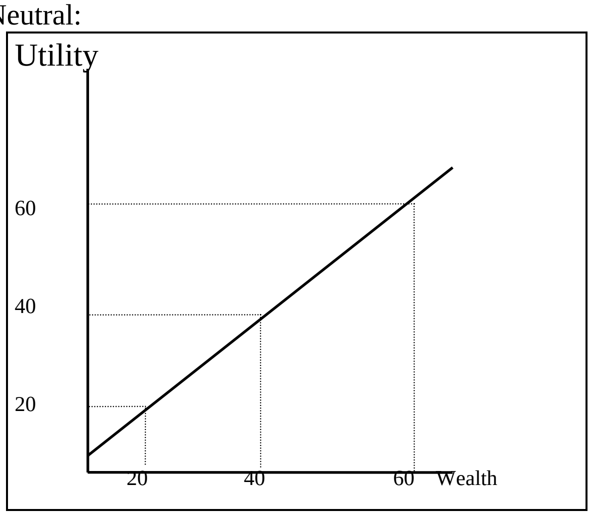
But a risk lover will act very differently:



For a Risk Loving person utility increases in wealth at an increasing rate : Increasing MU of income

Now this person if offered the same opportunity:
EU(1) = 1600
EU(2) = 2000
So a risk lover would go for the risky job.
That is a risk lover would accept a fair bet

Risk Neutral:

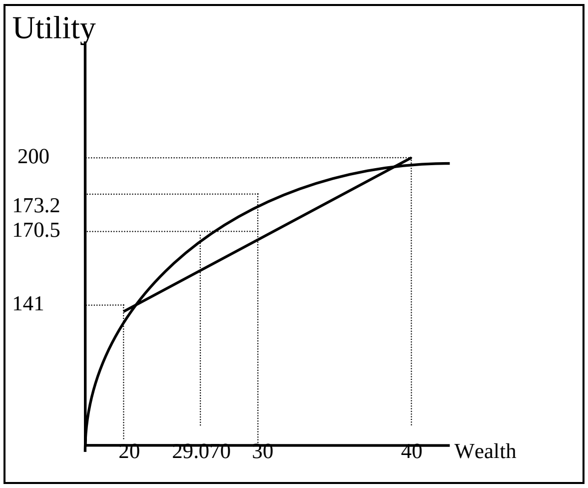


For a risk neutral person utility increases in income at a constant rate. So this person would be completely indifferent to a fair bet.

2. WHY PEOPLE BUY INSURANCE (or the demand for insurance):

We can use this theory to explain the market for health insurance
Suppose you think there is a .5 probability you will need surgery with a cost of $20,000 and suppose your income is 40,000.

Suppose your utility function is $U(W) = \sqrt{W}$
So that U(20,000) = 141
and U(40,000) = 200 and the expected utility of no insurance is 170.5



Now suppose you are offered an insurance policy that will cover all of your expenses in the event of illness and this will cost $10,000. Will you buy this?

If you do, you get 30,000 for sure and U(30) = 173.2. So yes, you would buy the insurance. You will be better off with the insurance than without (but note your expected income is 30k in both cases).

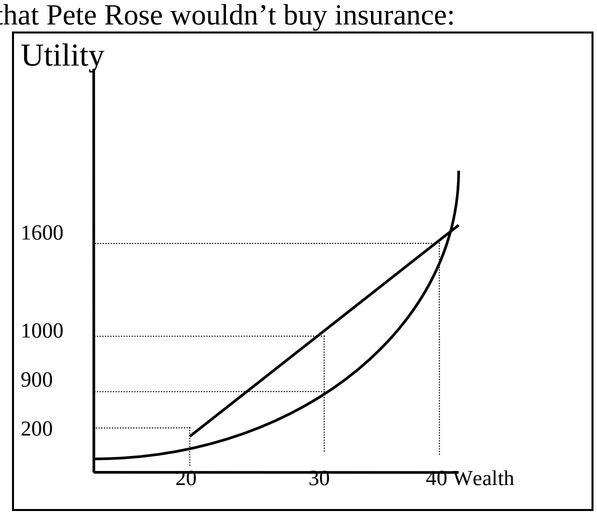
How much would you be willing to pay for insurance? Or at what income for sure would you be just indifferent to having no insurance? EU(no insurance) = 170.5

so find the W that solves: $\sqrt{W} = 170.5$ or $w = 170.5^2 = 29{,}070$

so if the insurance policy was 40,000-29,070=10,930 you would be just indifferent to buying the policy. This is know as a *Certainty Equivalent*

The more concave the utility function the larger this amount - or the more the person would be willing to pay to avoid risk.

Note that Pete Rose wouldn't buy insurance:



His utility from no insurance is 1000, but if he gets 30k for sure his utility is only 900 so he wouldn't want it. He would only buy insurance if the expected utility was higher with it than without it. So without it he will get an expected utility of 1000 find the wealth for sure that gives 1000 or $X^2 = 1000 = 31623$ so he would only pay 8377 for insurance.

But note that the insurance company would not be willing to sell insurance for this price!!

So the more risk averse a person is - or the more concave their utility function is - the more likely they will be to buy insurance

Also the lower your assessed probability of getting sick, the less likely you will be to buy insurance

Lots of uninsured people in the country - they deserve insurance?

Many are younger with low probability of getting sick, and who may not be very risk averse.

So many are uninsured by choice

Note it is the uncertainty that is important here, not necessarily the high cost of the adverse events. There are many high cost events in our lives that we do not have insurance for (my sons need braces, they will want to go to college, etc.) But the difference is that I know this and can plan for it (I know that in a few years I'll have to buy braces so I'd better save now). But with health care, the problem is that many events are not predictable. If I knew that in 5 years I would need heart surgery, I could (in theory) save enough to pay for it by then. But the problem is with uncertainty – there is a small chance that I will need it this year. It is this risk that insurance gets us out of.

An alternative way of looking at the insurance issue is from the standpoint of ability to pay. Note that heart surgery is pretty expensive, and even if I knew it was coming I might not be able to pay for it no matter how well I planned. But since it is a relatively unlikely event, it will only occur to a small fraction of the population. So insurance transfers money from healthy people to the sick and enables them to pay for highly valuable services they would otherwise be unable to afford.

Another Example:

Suppose your wealth = $400,000 and U(M) = √M
there is a probability = .001 you will need an operation which will cost $400,000 and reduce your wealth to zero. What is the most you would pay for insurance to cover this risk?

Without insurance EU = .001(0) + .999(√400,000) = 631.8

We want to find the insurance premium that gives you some level of wealth for sure that makes you just indifferent to not having insurance. Or u(m) = 631.8 or x - 631.8^2 = 399,200
or 400,000 - 399,200 = $800 is the maximum premium you would pay for this insurance.

Now suppose U(M) = ^{3}√M Will you pay more or less for this insurance?

EU no insurance = .999(73.68) = 73.6 so x = 73.6^3=398,688 for sure would give the same utility so you would pay 400,000 - 398,688 = 1312 for insurance.

Now what if your wealth is 1million Will this make you more or less willing to pay for the insurance?

EU(without) = 0.001(√600,000) + .999(√1m) = 0.775 + 999 = 999.775
so U(W) = 999.775 implies W = 99,955 so you would be willing to pay $450 for the same insurance.

Conclusions:

i. Insurance can be sold only in circumstances where there is diminishing marginal utility of wealth or income – risk aversion.
ii. Even though people will have less wealth as a result of the purchase of insurance, the increased well-being comes from the elimination of risk.
iii. Insurance, by pooling large groups of people with a low rate of incidence allows people to have more access to care than they would otherwise.

3. How *much* Insurance?

In the above examples the insurance was an either/or deal. But in reality there are levels of insurance. We can get a little more detailed and ask how much insurance will an individual buy to cover a given potential loss.

Suppose your current wealth is 20,000, and there is a .05 probability of being ill which would result in a loss of 10,000

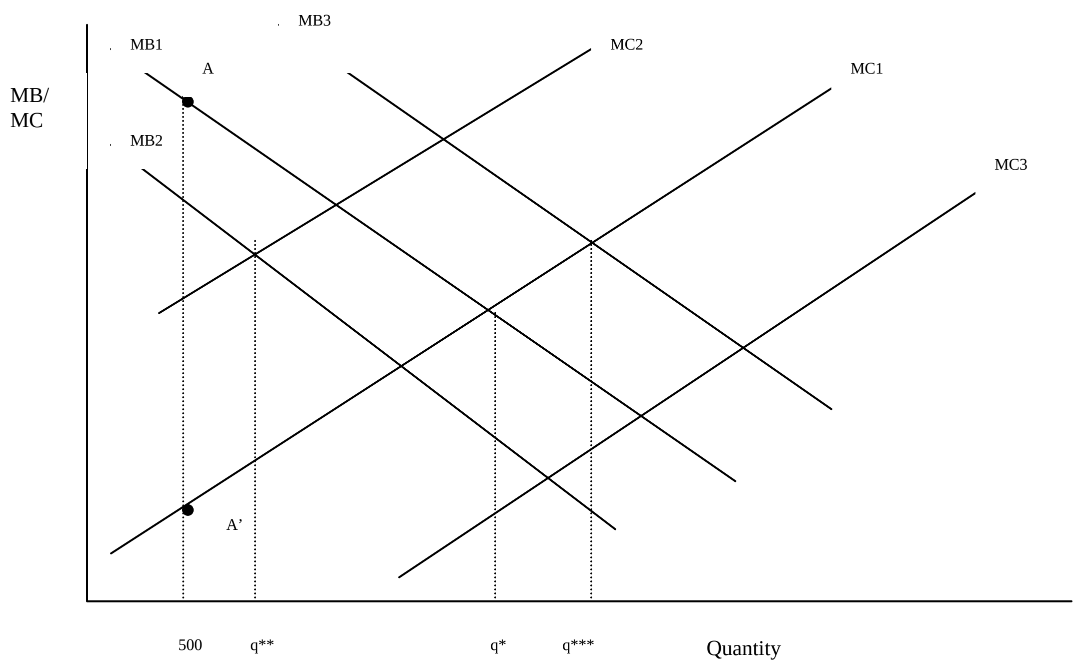
How much of this potential loss should you insure against? To find the answer we deal with the marginal costs and benefits. Suppose insurance is sold in $500 increments. So the idea is: should you purchase the first $500 worth of coverage? You will as long as the expected marginal benefits are greater than the expected marginal costs. Then you will compare the marginal benefits and costs of the next $500 of coverage, and will continue until the expected marginal benefit is just equal to the expected marginal costs.

Suppose the cost of insurance is a 10 percent premium, so each $10 worth of coverage costs $1. so a $500 policy will cost $50.

Thus if you start with a wealth of 20k, your wealth if ill becomes:

	Original wealth:	$20,000
less	Loss	10,000
	Remainder	10,000
Plus	Insurance	500
	Sum	10,500
Less	premium	50
	New Wealth	$10,450

If you are not ill, your wealth becomes 20k-50 or $20,950. So the marginal benefit from the $500 in insurance is the expected marginal utility that the additional $450 brings. The marginal cost is the expected marginal utility that the $50 premium costs.



In the above graph the marginal cost of insurance is initially shown in the curve MC1, so the first 500 has a marginal cost at point A' and a marginal benefit at point A, and so you would be better off with this first 500 in coverage.

Now we can ask should you increase coverage from 500 to 1000? Note that the marginal utility from an additional 450 in wealth in the event of illness will be slightly lower than before (since you are starting at a wealth of 10,450 rather than 10,000). This assumes diminishing marginal utility of wealth. So the marginal benefits of the additional coverage will be lower than before. Thus the marginal benefit curve is downward sloping.

Likewise the marginal cost will increase. Since you are starting at a slightly lower level of wealth (19,950 rather than 20k), the marginal cost associated with another 50 in premium is larger (since it means giving up a larger amount of utility than associated with the first 50). Therefore, the marginal cost curve is upward sloping.
Thus, the optimal level of insurance is where the MB=MC or q*

Change in premiums

How does the decision change if the premiums change? Say that there is a 15% rather than a 10% charge.

	Original wealth:	$20,000
less	Loss	10,000
	Remainder	10,000
Plus	Insurance	500
	Sum	10,500
Less	premium	75
	New Wealth	$10,425

Now the new wealth when ill falls to 10,425, and the wealth when well goes to 19,925. Now you only get an extra 425 when ill. So this will lie on a new marginal benefit curve (MB2 above). At the same time the marginal cost is the expected marginal utility that the new premium costs. This will be greater than when the premium is 50, so the new marginal cost curve is above the original one. So the new equilibrium is at q**, the result is less insurance.

Changes in Expected Loss

Now what if instead of losing 10k in the event of illness, the loss is 15k. How does this change things? If the premium is still 50 per 500 in coverage, then the expected wealth if healthy doesn't change (it is still 19,950). So the MC curve is still MC1. The marginal benefits do change though:

	Original wealth:	$20,000
less	Loss	15,000
	Remainder	15,000
Plus	Insurance	500
	Sum	5,500
Less	premium	50
	New Wealth	$5,450

So note that the insurance still gives him 450 in wealth if he is ill so in some sense it is unchaged. But note that this is starting at a wealth of 5k instead of 10k. An extra 450 when you have 5k in wealth will bring more utility than if you have 10k in wealth, thus the MB curve shifts to the right to MB3 and so the new equilibrium is where MB3 crosses MC1, or point q*** . A larger loss in the event of illness results in a larger level of coverage.

Changes in Wealth

Now suppose you start with a wealth of $25k instead of 20k. If the premium rate is still 10%:

	Original wealth:	$25,000
less	Loss	<u>10,000</u>
	Remainder	15,000
Plus	Insurance	<u>500</u>
	Sum	15,500
Less	premium	<u>50</u>
	New Wealth	$15,450

Note that at a higher level of wealth an extra 450 provides a smaller increment in utility, so the marginal benefit curve will shift down to MB2. But also the 50 premium lowers wealth from to 24950 and since this is a higher level than 19950, she gives up less utility to buy the policy, so the marginal cost curve shifts to the right to MC3. In the graph above this results in an increase relative to q*. However the actual effect is ambiguous. The decrease in MB will tend to decrease coverage, while the decrease in MC will tend to increase coverage. The two effects are working against each other and so the final effect depends on which is dominant.

4. **<u>The supply of insurance</u>**

Now consider the insurance company's problem:

From the insurer's perspective it is about profits. Profit = TR-TC. If we go back to thinking of buying policy's in 500 increments, and they are paying a premium of 10%. The profit per unit of coverage will be:

Profit = 50 – (Prob of illness – cost of illness) – (prob of no illness – cost of no illness). Assume at first that the only cost are medical so if the consumer is not ill the insurance has no costs, then if there is a 5% chance of illness:

Profit = 50 –(.05*500) = $25. So positive profits at this price. Note that this can't last in a competitive market since entry will occur which will bid the price down. Entry will occur until profits are zero. In this case the price gets bid down until the premium is .05 or the premium is equal to the probability of illness.

Now lets say that we allow a $5 per unit administrative cost. Then the zero profit price will be a .06:

$$.06*500 – (.05*505)-(.95*5)=0.$$

Let a be the premium in factional terms, q the payout, p the probability of illness and t the administrative (or transaction) costs. Then:

Profit = aq – (pq-t)

If the market is competitive, then profit =0

0 = aq-pq-t Solving for a gives

a = p +t/q
so t/q is the administrative (or loading costs) as a percentage of the policy value.
This is known as the **actuarially fair premium**

With no loading cost under competition, a=q in equilibrium. It turns out that from the consumer's standpoint it turns out that it is optimal for the consumer to add coverage up to the point where expected wealth is equal in both states of the world. That is $Wealth_{well} = Wealth_{ill}$.
So $Wealth_{well} = 20{,}000 - aq$
$Wealth_{ill} = 20{,}000 - 10{,}000 + q - aq$
Then $20{,}000 - aq = 20{,}000 - 10{,}000 + q - aq$
Or q= 10,000. In this case the optimal level of coverage is funn coverage for the loss.
But in a world with positive loading costs, the optimal level of coverage falls below full coverage.

Recall the moral hazard problem
The above assumed behavior did not change as a result of insurance. But we know that it will. So that the consumption will increase and so the premium of 1,000 would tend to be too little to cover the insurer's costs. So in order to cover costs rates increase.

Thus an insurance premium has two components. The first is the premium for protection against risk, assuming that no moral hazard exists. The second is the extra resource cost due to moral hazard.

Experience rating alleviates moral hazard – car insurance vs. health insurance.

But note that experience rating reduces the income transfer effect from the healthy to the sick that allows more access to care.