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Principles of Economics

Consumer Behavior and Utility Maximization

Throughout our lives each of us makes choices that contribute to our happiness. Economists want to know how we make these choices, because if economists know how people behave then they may be able to predict how they will react to various events. (How, for example, will people respond if their taxes are cut? How much more money will they save? Will they work harder or less hard? What and how much more will they buy?)

In a nutshell, here's the prevailing theory: an individual measures the expected benefits of an action against its costs; the rational consumer makes choices in which the benefits are high relative to the costs.

Consider this ratio: benefit/cost

The rational individual makes the choices in which this benefit/cost ratio is the highest.

Economists study many different types of choices; three important ones are:

1. How does an individual decide what and how much to buy?
2. How does an individual decide how much to work?
3. How does and individual decide how much to save?

We shall examine these choices more closely below.

But first, a few definitions. How do economists measure happiness?

Utility: means happiness, or well-being

Total utility: is the total amount of happiness experienced by the individual. Economists usually assume that *it is the goal of the individual to maximize her/his total utility*.

Marginal utility: is the increase in total utility when 1 more unit of an activity is undertaken. Example: consider the activity "consuming potato chips." Here's a chart representing a hypothetical individual's marginal chip utility and total chip utility:

Example: (below, we measure utility in units known as *utils*)

Potato chips eaten	Marginal chip utility	Total chip utility
0	--	0
1	50	50
2	40	90
3	30	120
4	15	135
5	5	140

Diminishing marginal utility: Note from the above table that all 5 of the chips add to the individual's total utility (happiness). But the 2nd chip adds less marginal utility than the 1st chip; the 3rd chip adds less utility than the 2nd chip, etc. This is known as *the law of diminishing marginal utility*; marginal utility falls as consumption of a good rises.

Enough with the definitions. Let's look at consumption of goods and services, and try to develop a rule that the individual can follow to purchase the types and amounts of things that maximize her/his utility.

Consumption: What and how much of each good should a person buy?

A consumer does not randomly expend her income on haphazard goods and services; rather, she buys the products which both give her much satisfaction and are relatively cheap. For example, a vegetarian would definitely NOT spend $1000 for a pound of hamburger, but she would happily spend five cents for ten pounds of vegetables.

Economists give structure to these general observations by saying that a "rational" consumer (a person who can distinguish which products she likes and dislikes, and can rank them from best to worst) with a limited budget will consume goods and services in an amount that maximizes her total utility. Mathematically, this utility-maximizing consumer will purchase the types and amounts of goods and services that yield the greatest marginal utility per dollar available, until her income is exhausted. When the consumer follows this purchasing strategy, she will find that after all of her income has been spent, the marginal utility per dollar of all the products she consumed will be equal.

To illustrate this economic concept, consider the following simplified example: A rational consumer has $5 of income, which she can spend on either apples or oranges. Each apple costs $1, and each orange costs $1. The consumer can gain the following marginal utility from each fruit:

Apples Consumed	Marginal Utility	Oranges Consumed	Marginal Utility
1	400	1	350
2	300	2	200
3	200	3	150
4	100	4	50
5	50	5	25

(Note that this example is consistent with the law of diminishing marginal utility, in that as successive units of each good are consumed, the marginal utility of each good is falling.)

So, the question is, how many of each good should the consumer buy in order to maximize her total utility? (Note that total utility is the sum of the marginal utilities.)

For example, if the consumer were to spend her entire $5 budget on apples, her total utility would equal

400 + 300 + 200 + 100 + 50 = 1050 total utils

For another example, if the consumer were to spend her entire $5 on oranges, her total utility would equal

350 + 200 + 150 + 50 + 25 = 775 total utils

But neither of these examples uses the $5 wisely; there is some other combination of apples and oranges that provides more total utility!

Utility-maximizing rule: the consumer should purchase the goods available which give her the highest marginal utility per dollar, until her income is exhausted. The first fruit she should purchase is an apple, since it is the good available which gives her the highest utility per dollar:

STEP 1: Buy first apple. It provides 400 utils per dollar (400/$1).
Its marginal utility is 400, so it adds 400 to total utility.

AFTER STEP 1: Total utility equals 400. Income remaining is $4

Next she should buy the first orange, since it now is the good available which provides the highest marginal utility per dollar. (The first apple is no longer available, since she's bought that one already in step 1.)

STEP 2: Buy 1st orange. It provides 350 utils per dollar (350/$1).
Its marginal utility is 350, so it adds 350 to total utility.
AFTER STEP 2: Total utility = 400 + 350 = 750. Income left is $3.

Next she should buy the second apple, since it now is the good available which provides the most marginal utility per dollar.

STEP 3: Buy 2nd apple. It provides 300 utils per dollar (300/$1).
Its marginal utility is 300, so it adds 300 to total utility.
AFTER STEP 3:Total utility = 400+350+300 = 1050. Income left is $2.

Next she should buy either the third apple or the second orange, since either of these goods will provide the same (and highest available) utility per dollar. Let's assume that she buys the third apple.

STEP 4: Buy 3rd apple. It provides 200 utils per dollar (200/$1).
Its marginal utility is 200, so it adds 200 to total utility.
AFTER STEP 4:Total utility=400+350+300+200 = 1250. Income left is $1.

Finally, she should buy the second orange, since it now is the good available which provides the most marginal utility per dollar.

STEP 5: Buy 2nd orange. It provides 200 utils per dollar (200/$1).
Its marginal utility is 200, so it adds 200 to total utility.
AFTER STEP 5:Total utility=400+350+300+200+200=**1450**. Income left is $0.

Thus this fictitious consumer has maximized total utility (equal to 1450 utils) by consuming 3 apples and 2 oranges. Note that she has satisfied the utility maximizing rule, as we would expect; that is, the marginal utility per dollar of apples at her consumption of 3 apples is:

Marginal utility of third apple / price of an apple = 200/$1 = 200

and the marginal utility per dollar of oranges at her consumption of 2 oranges is:
Marginal utility of 2nd orange / price of an orange = 200/$1 = 200

So both are the same! Hooray! She's maximizing utility! Zowie!

More generally:

1) A rational consumer maximizes total utility.

2) This maximization is accomplished by purchasing the types and amounts of products available which yield the highest marginal utility per dollar.

3) After the utility-maximizing person has exhausted her income, the marginal utility per dollar of all of the products she consumes will be equal. (This is the "utility-maximizing rule.")

Applying Utility-Maximization Theory: Test your knowledge of utility-maximization theory by applying it to specific situations through answering the following questions:

(Answers appear on subsequent pages)

Questions

1. Dr. McCoy has $17 to spend on soda and/or beer and/or wine. Beer costs $2 per unit, Soda costs $1 per unit, and wine costs $4 per unit.
McCoy's marginal utilities for these beverages are listed below:

Units of Product	MU of Soda	MU of Beer	MU of Wine
1	10	50	60
2	9	40	40
3	8	30	32
4	7	20	24
5	6	16	20
6	5	12	16

a) What combination of beverages should Dr. McCoy purchase in order to maximize total utility?

b) Calculate Dr. McCoy's total utility.

c) Use the utility-maximizing rule to verify that Dr. McCoy has indeed maximized his utility.

2. Mr. Spock has purchased shirts and slacks in such a manner that when his income was exhausted, the marginal utility of shirts is 1000 utils, and the marginal utility of slacks is 2000 utils. Shirts cost $10 a piece; slacks are $25.

a) Has Mr. Spock maximized his total utility? Explain.

b) How should Mr. Spock change his consumption pattern to increase his total utility; i.e. should he consume more or fewer shirts? More or fewer slacks? Explain.

3. Captain Kirk has eaten Twinkies and Ding Dongs in such a manner that when his income was exhausted, the marginal utility of Twinkies is 100 utils, and the marginal utility of Ding Dongs is 50 utils. Twinkies are $1 a piece; Ding Dongs are 50 cents.

a) Is Kirk maximizing his total utility? Explain.

b) Now suppose that the price of a Ding Dong falls to 25 cents (while the price of Twinkies remains the same.) Should Kirk consume more or fewer Ding Dongs as a result of the price reduction? Explain using the utility maximizing rule.

c) Was Captain Kirk's response in (b) consistent with the Law of Demand? Explain.

d) Can you see now how the Law of Diminishing Marginal Utility is directly related to the Law of Demand? (That is, that diminishing marginal utility leads to more of a product being demanded at a lower price?) I hope so. Beam me up, Scotty.

Answers

1. Dr. McCoy has $17 to spend on soda and/or beer and/or wine. Beer costs $2 per unit, Soda costs $1 per unit, and wine costs $4 per unit.
McCoy's marginal utilities for these beverages are listed below:

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4	7	20	24
5	6	16	20
6	5	12	16

a) What combination of beverages should Dr. McCoy purchase in order to maximize total utility? *One soda, 4 beers, 2 wine*

b) Calculate Dr. McCoy's total utility.

10 + 50 + 40 + 30 + 20 + 60 + 40 = 250 utils

c) Use the utility-maximizing rule to verify that Dr. McCoy has indeed maximized his utility.

MU/p for soda = 10/$1 = 10 utils per dollar
MU/p for beer = 20/$2 = 10 utils per dollar
MU/p for wine = 40/$4 = 10 utils per dollar

2. Mr. Spock has purchased shirts and slacks in such a manner that when his income was exhausted, the marginal utility of shirts is 1000 utils, and the marginal utility of slacks is 2000 utils. Shirts cost $10 a piece; slacks are $25.

a) Has Mr. Spock maximized his total utility? Explain.

No. MU/p for slacks does not equal MU/p for shirts:
MU/p for slacks = 2000/25 = 80 utils per dollar
MU/p for shirts = 1000/10 = 100 utils per dollar

b) How should Mr. Spock change his consumption pattern to increase his total utility; i.e. should he consume more or fewer shirts? More or fewer slacks? Explain.

Spock was getting more utils per dollar from shirts—he should have bought more of them. Meanwhile, he was getting fewer utils per dollar from slacks—he should have bought fewer of them.

3. Captain Kirk has eaten Twinkies and Ding Dongs in such a manner that when his income was exhausted, the marginal utility of Twinkies is 100 utils, and the marginal utility of Ding Dongs is 50 utils. Twinkies are $1 a piece; Ding Dongs are 50 cents.

a) Is Kirk maximizing his total utility? Explain.

Yes! MU/p for ding dongs = MU/p for Twinkies
MU/p for ding dongs = 50/.5 = 100 utils per dollar
MU/p for Twinkies = 100/1 = 100 utils per dollar

b) Now suppose that the price of a Ding Dong falls to 25 cents (while the price of Twinkies remains the same.) Should Kirk consume more or fewer Ding Dongs as a result of the price reduction? Explain using the utility maximizing rule.

The new MU/p for Ding dongs = 50/.25 = 200 utils per dollar. Ding-dongs are now a better deal than Twinkies; Kirk should buy more of them.

c) Was Captain Kirk's response in (b) consistent with the Law of Demand? Explain.

Yes. A lower ding-dong price makes Kirk buy more ding-dongs.

d) Can you see now how the Law of Diminishing Marginal Utility is directly related to the Law of Demand? (That is, that diminishing marginal utility leads to more of a product being demanded at a lower price?) I hope so. Beam me up, Scotty.

Yes.

Total Utility Graphed

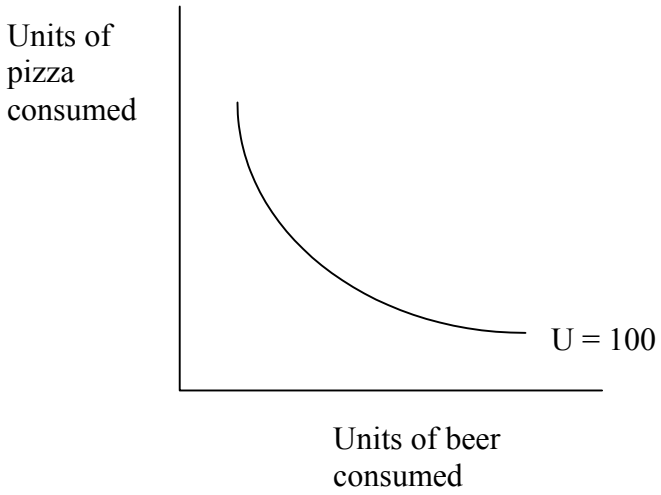
One can use indifference curves to graph a person's prospective total utility levels

An *indifference curve* represents all combinations of two goods that provide the individual with an equal level of total utility.

Example: Suppose that we know that each of these combinations of pizza and beer give Biff a total or 100 utils of utility:

point	**Units of beer**	**Units of pizza**	**Total utility**
A	100	100	100 utils
B	90	107.3	100 utils
C	80	116	100 utils
D	70	126.8	100 utils

Example continued: If we graphed the points from the table and connected them, then we'd get a nice indifference curve that looks like this:



Utility maximization and indifference curves: For any person, she really has an infinite number of indifference curves—one for each possible utility level. It is generally desirable for the individual to "get on" the highest indifference curve that she is able to (given any constraints that she faces); this indicates that she is maximizing her total utility.

Constraints facing the individual

No individual can attain an infinitely high level of utility. This is because each individual faces some barriers, or constraints, that limit her feasible choices. Generally one faces *time* constraints and income *constraints*. In addition, one must usually buy the things that one consumes.

We shall often ignore (explicitly, anyway) the time constraint and consider only the income constraint

Income constraint: specific example
Consider Bozo, who can buy two goods, cheese and donuts, at price $5 per unit of cheese and $2 per unit of donuts. Suppose that Bozo has $100 of income
.

Bozo's budget constraint can be written

5(units of cheese) + 2(units of donuts) = 100

For ease of graphing, we can solve this equation for units of donuts:

Units of donuts = 100/2 – (5/2)(units of cheese)

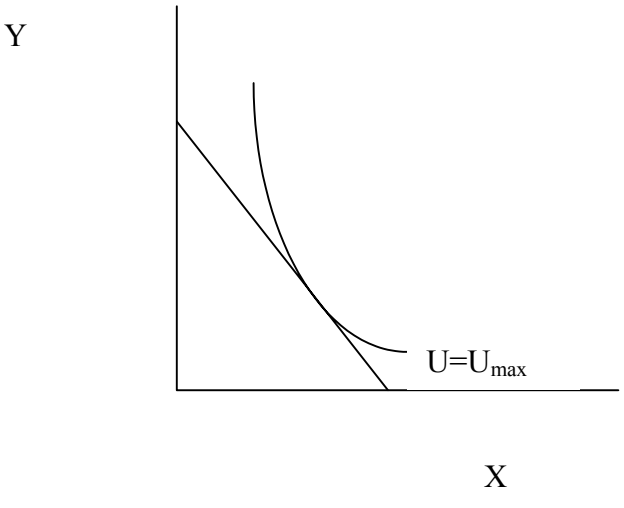
Hence Bozo's income constraint is a negatively-sloped line with vertical intercept 50 and slope –2.5:

Interpretation of the income constraint. With her limited income, the individual can only afford to consume combinations of goods *on or inside* the budget constraint. (By "inside the budget constraint," I mean between it and the origin.) This is sometimes called the *feasible area*.

Utility Maximization Graphed

The highest indifference curve that one can "get on" must have at least one of its points in the feasible area. Usually, in fact, it only has 1 point in the feasible area.

Example :



Now let's look at another choice facing the individual—how much to work

How much to work? The income-leisure tradeoff

Suppose that you decide to take an hour off from work, and as a result you don't get paid for that hour.

Your benefit: You got to enjoy an hour of leisure
Your cost: Lost wages

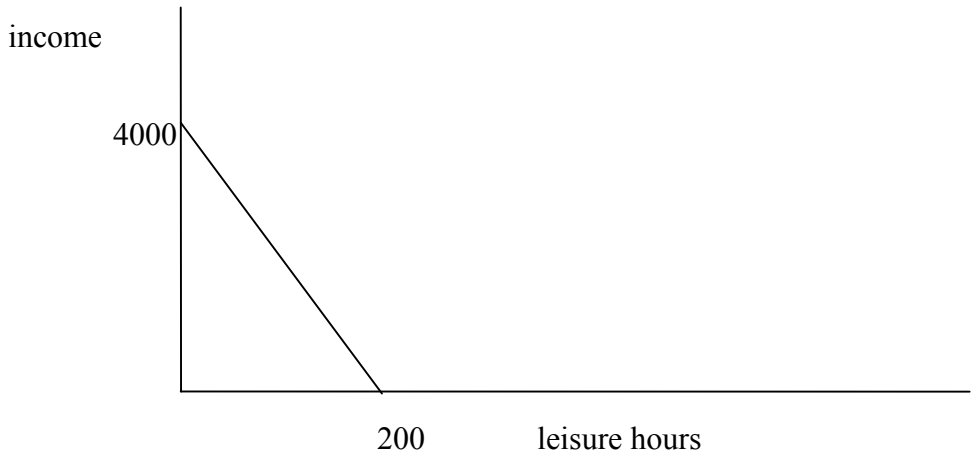
In general, the benefit of not working is the leisure that you enjoy; the cost is lost wages.

Simplified example: Consider Cracko T. Parrot. He has 200 hour per month; for each hour, he can either work, earning $20 per hour, or not work, gaining leisure.

Here are some combinations of earned income and leisure that he, Cracko T. Parrot can choose from:

hours of leisure	0	50	100	150	200
earned income	$4000	$3000	$1500	$1000	$0

If we graphed the above (5) points and connected them with a straight line, then we'd have Cracko's *income-leisure constraint*:



<u>How does one react to a change in wage? Income vs. substitution effects</u>

Suppose that you can pick how many hours that you work. Now, your take home wage per hour rises (perhaps due to a nice tax cut from G.W. Bush). Will you work *more* or

fewer hours? Oh, what a dilemma! You are being pushed in two directions by two different effects:

1. *The income effect*. You can now work fewer hours and still have the same total take home pay that you had when your wage was low. This effect makes you want to work fewer hours.

2. *The substitution effect*. The reward for an hour of work is now higher than before. This effect makes you want to work more hours.

The overall effect is the combination of the income effect and the substitution effect. For some people, the income effect will dominate; these people will work fewer hours. For other people, the substitution effect will dominate; these people will work more hours.

Now let's look at one more important choice: how much to save.

How much to save? The intertemporal budget constraint

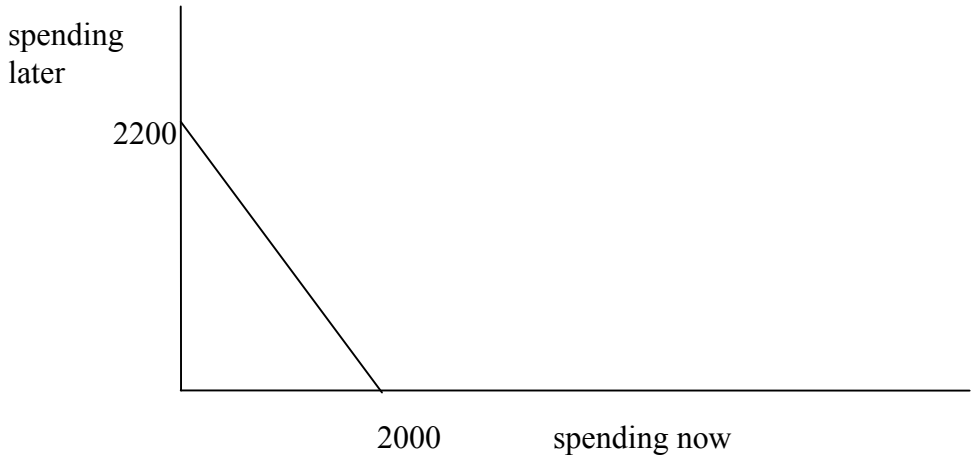
A dollar saved can be spent later along with the interest that is earned. That's the dilemma: when you save a dollar, you give up the chance to buy stuff today while you gain the chance to buy stuff later.

Simplified example: Consider Jim Nasium. He has $2000; each dollar he can spend now or save, earning 10% interest. (He has no other money.)

Here are some combinations of *spending now* and *spending later* that he, Jim Nasium, can choose from:

spending now	$0	$500	$1000	$1500	$2000
spending later	$2200	$1650	$1100	$550	$0

If we graphed the above (5) points and connected them with a straight line, then we'd have Jim's *intertemporal budget constraint*:



How does one react to a change in interest rates? Income vs. substitution effects

Suppose that the interest rate that you can earn rises (perhaps due to a nice tax cut from G.W. Bush). Will you save *more* or *fewer* dollars? Oh, what a dilemma! You are being pushed in two directions by two different effects:

1. *The income effect*. You can now save fewer dollars and still have the same amount to spend later that you had when your interest rate was low. This effect makes you want to save less.

2. *The substitution effect*. The reward for a dollar of savings is now higher than before. This effect makes you want to save more.

The overall effect is the combination of the income effect and the substitution effect. For some people, the income effect will dominate; these people will save less. For other people, the substitution effect will dominate; these people will save more.