Unit 2.1: Consumer Theory (Graphical Presentation): Model Setup

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1 Consumer Choice Problem

A consumer chooses among many different goods – which goods to buy and how much to buy of each good. In order to simplify the problem (particularly to make graphical analysis possible), we often reduce the problem to only two goods over which the consumer can choose. A *bundle* is some combination of the two goods.

We can depict different bundles as different points on a diagram, as in figure 1. Throughout, we will use fish and apples as our two goods.

For example, the bundle containing 7 fish and 4 apples is represented by point A. The bundle containing 4 fish and 9 apples is represented by point B. The bundle containing no fish and 5 apples is represented by point C. Each point on the graph is a different bundle.

Note that what's measured on the axes of this graph are just *quantities* of the two goods. Not prices and not dollar amounts – just different quantities.

2 The Budget Constraint

The consumer can't just choose any bundle he wants to choose. The bundle has to be affordable. The *budget constraint* is the set of all bundles that use up the consumer's income, given the prices of the two goods.

For example, suppose that the price of a fish is \$3, the price of an apple is \$3, and that the consumer has \$12 of income to spend. The line in Figure 2 shows all of the bundles that the consumer can choose in order to spend his \$12.

As shown in figure 2, one choice is to buy 4 fish and no apples. At \$3 per fish, this spends the consumer's \$12. Alternatively, the consumer could choose to buy 4 apples and no fish; this also spends his \$12. There are other possibilities, too. For example, the bundle with 2 fish and 2 apples also costs \$12.

A simple, linear budget constraint is easy to draw. Just figure out the two endpoints: How many fish could the consumer buy if he spent *all* his money on fish? How many apples could he buy if he spend *all* his money on apples? Then draw a straight line connecting these endpoints.

Budget lines can get more complicated, for example when stores follow a pricing strategy that leads to a different per-unit price depending upon the number of units bought (e.g. products with a quantity discount). Also, public policies sometimes create strange-looking budget constraints. You will study these more in labor economics or public economics classes. In this class, we will focus on the simple linear budget constraint, which is enough to understand the basic consumer choice model.

The *price ratio* is the price of the good measured on the X axis divided by the price of the good measured on the Y axis. The slope of the budget line is the negative of the price ratio:

$$slope_{budget} = -\frac{P_X}{P_Y}$$

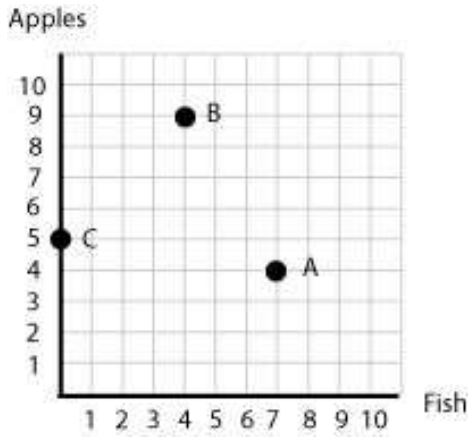

Figure 1: Different Bundles

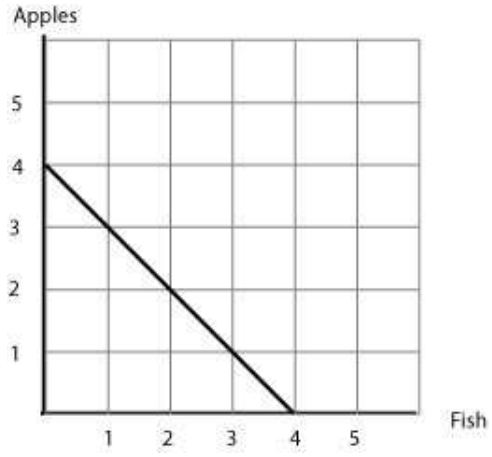

Figure 2: A Budget Line

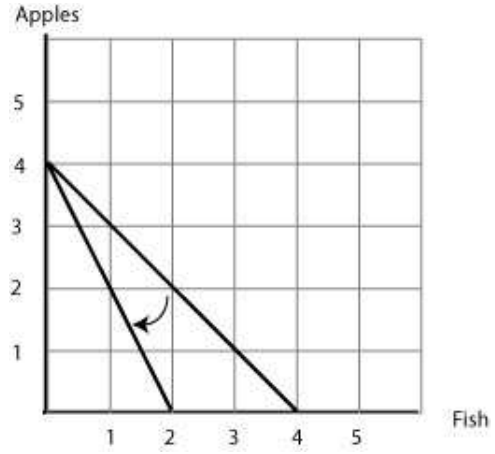

Figure 3: An increase in the price of fish

In this case, the price of fish is 3 and the price of apples is 3. This means that the price ratio is 1, and so the slope of the budget line is

$$slope_{budget} = -\frac{P_X}{P_Y} = -\frac{3}{3} = -1$$

The price ratio represents *the number of units of good Y that the consumer must give up in order to obtain one more unit of good X*. For example, when apples and fish each cost \$3, the consumer gives up one apple (the good on the Y axis) in order to obtain one more fish (the good on the X axis).

Suppose now that the price of fish increases to \$6, with the price of an apple remaining at \$3. If the consumer spends all his \$12 income on fish, he can only afford 2 fish. If he spends all his income on apples, again he can afford 4 apples. The new budget constraint is shown in figure 3.

Notice that a price increase pivots the budget line *inwards* along the axis measuring the good whose price rose. Intuitively, a price increase means that the consumer can now afford less of the good, so the budget line pivots inwards. Conversely, a decline in the price of fish means that the consumer can afford more fish, pivoting the budget line *outwards*.

With the new prices, the price ratio is now:

$$\frac{P_X}{P_Y} = \frac{6}{3} = 2$$

Geometrically, the budget line is twice as steep, with a slope of $-\frac{P_X}{P_Y} = -2$. Since the price ratio is 2, this means that the consumer now has to give up 2 apples in order to obtain one more fish. This makes intuitive sense since fish are now twice as expensive as apples.

Now suppose that both the price of fish and apples remained at \$3, as before, but that the consumer's income increases from \$12 to \$15. In this case, the consumer can now afford 5 fish if he spends all his money on fish, and 5 apples if he spends all his money on apples. The new budget line is shown in figure 4.

As shown, an increase in income causes a parallel shift of the budget constraint. Intuitively, an increase in income increases the amount of both goods that the consumer can afford. The slope of the new budget line is the same as the slope of the original budget line since the price ratio did not change. Conversely, a decline in income shifts the budget line parallel inwards.

To reiterate this point – a change in the *price* of a good *pivots* the budget line and changes its slope. Changes in *income* result in a *parallel shift* in the budget line.

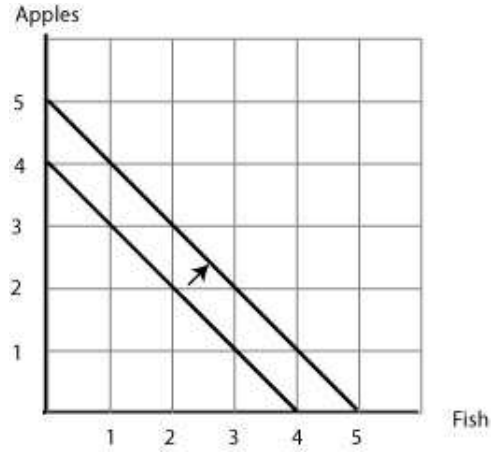

Figure 4: An increase in income

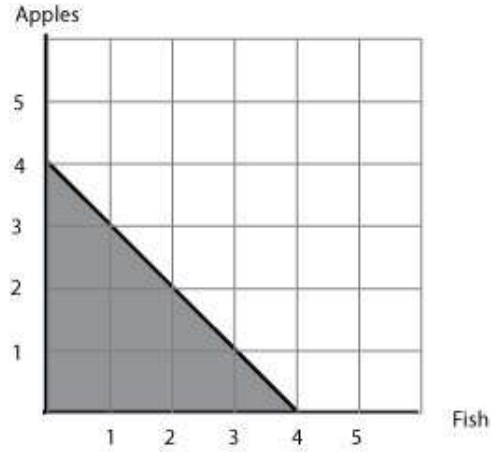

Figure 5: Set of affordable bundles

An *affordable bundle* is any bundle that the consumer can afford, given his income and the prices of the goods. The set of all affordable bundles includes the bundles on the budget line and all bundles inside the budget line. Bundles on the budget line use all of the consumer's income. Bundles inside the budget line are affordable but do not use up all of the consumer's income. The set of affordable bundles is shown in figure 5.

3 Indifference Curves

Having dealt with what a consumer is *able* to buy, we will now deal with what a consumer *wants* to buy. An *indifference curve* represents various bundles that all make a consumer equally well-off. That is, the consumer likes every bundle on an indifference curve equally well.

Let's begin with the bundle containing 1 fish and 12 apples. Because the consumer has a lot of apples and not very many fish, this consumer might be willing to give up 5 apples in order to obtain one more fish. In other words, the consumer likes the bundle containing 1 fish and 12 apples just as well as he likes the bundle containing 2 fish and 7 apples. Both of these bundles are on the same indifference curve. See figure 6.

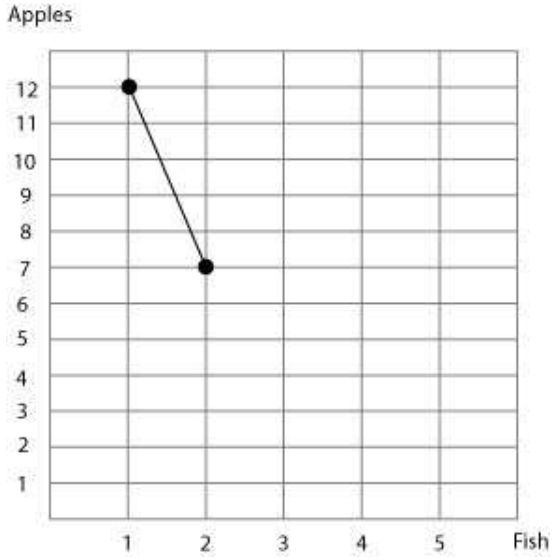

Figure 6: Indifference Curve

The *marginal rate of substitution* (MRS) is the amount of good Y that the consumer is willing to give up in order to obtain one more unit of good X. In this case, the MRS is 5 since the consumer was willing to give up 5 apples in order to obtain one more fish. Graphically, the MRS is just the negative of the slope of the indifference curve.

Now, once the consumer already has 2 fish and 7 apples, it is unlikely that the consumer would be willing to give up another 5 apples in exchange for a third fish. Since the consumer already has more fish (and fewer apples), an additional fish is not as valuable. Let us say that the consumer would be willing to give up only 3 apples to obtain another fish. Therefore, another bundle on the indifference curve is the bundle containing 3 fish and 4 apples. See figure 7. The marginal rate of substitution is 3 over this interval.

Now, when the consumer already has 3 fish (and 4 apples), he might only be willing to give up 2 apples to obtain another fish. So, another point on the indifference curve is the bundle containing 4 fish and 2 apples. The MRS is 2 over this interval.

Once the consumer already has 4 fish (and 2 apples) he might only be willing to give up 1 apple to obtain another fish. So, another point on the indifference curve is the bundle containing 5 fish and 1 apple. The MRS is one over this interval. Figure 8 diagrams out all the points we have obtained on this indifference curve.

To reiterate, in figure 8, *every bundle on this curve leaves the consumer equally well off.* The consumer likes every one of these bundles equally well. This is the definition of an indifference curve.

Notice that the marginal rate of substitution is not constant along the indifference curve. In fact, indifference curves typically obey the *law of diminishing marginal rate of substitution.* As a consumer obtains more of good X (fish), he is willing to give up fewer units of good Y (apples) in order to obtain an *additional* unit of good X. This makes good intuitive sense. If you have very few fish, you'd probably give up a lot of your apples to obtain another one. However, if you already have a lot of fish, you're not willing to give up so many apples to get another one.

Graphically, what this means is that MRS declines as we move rightwards along an indifference curve – the curve flattens out as we move rightwards. This property is what gives indifference curves their characteristic convex shape shown in figure 9.

The MRS is high when the consumer has few fish – the consumer is willing to give up a lot of apples to obtain another fish; the indifference curve is steep. The MRS is lower when the consumer has more fish

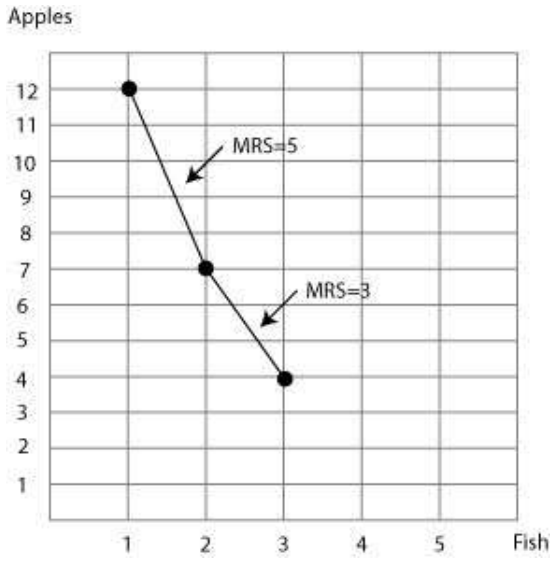

Figure 7: Indifference Curve with additional point

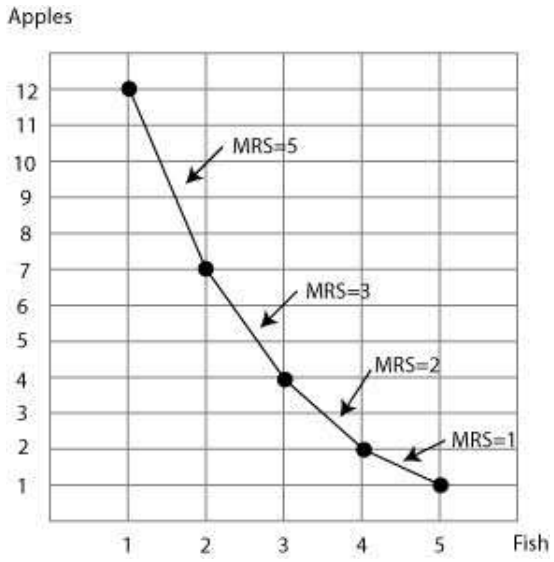

Figure 8: Indifference Curve with additional points

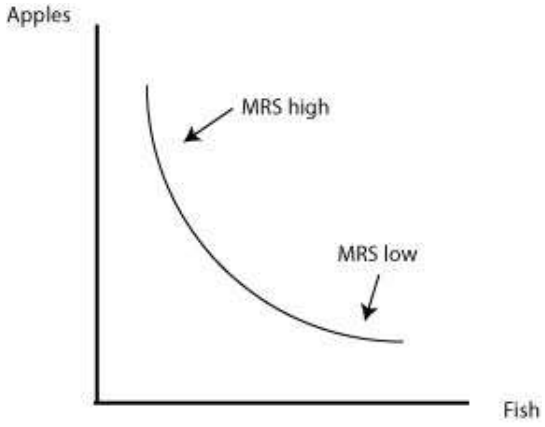

Figure 9: Typical indifference curve

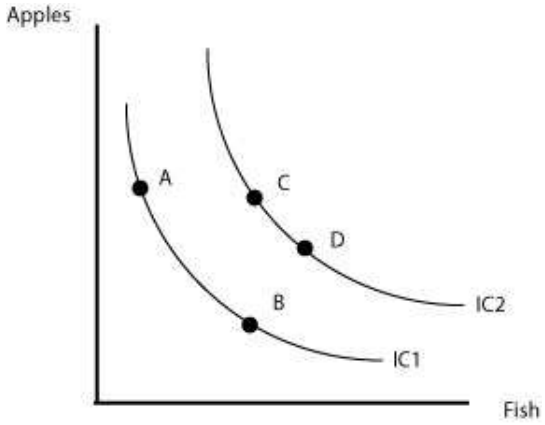

Figure 10: Indifference Map

– the consumer is not willing to give up very many apples to obtain another fish; the indifference curve is flatter.

To reiterate one more time, every point on an indifference curve leaves the consumer equally well off.

4 Indifference Maps

It is clearly possible to draw more than one indifference curve. An *indifference map* shows multiple indifference curves. See figure 10.

For the indifference map in figure 10, notice that indifference curve IC2 contains more of both goods than indifference curve IC1. To make this more explicit, the consumer likes bundles A and B equally well, since bundles A and B are on the same indifference curve. Also, the consumer likes bundles C and D equally well since both are on the same indifference curve. The consumer prefers bundles C and D to bundles A and B since bundles C and D are on a higher indifference curve.

5 Properties of Consumer Preferences

There are five properties that consumer preferences (represented by indifference curves) typically obey.

1. Preferences are **complete**. This means that a consumer is able to rank any two bundles. In other words, for any two bundles that I name A and B, the consumer is able to tell me that he prefers A, prefers B, or likes both the same. Geometrically, this property means that we are able to draw indifference curves. If a consumer was unable to say which of two bundles he preferred, it would be impossible to represent his preferences over these bundles.

2. Preferences are **transitive**. This means that if a consumer prefers bundle A to bundle B and the consumer prefers bundle B to bundle C, then the consumer must prefer bundle A to bundle C. For example, if I prefer pizza to ice cream, but like ice cream better than carrots, then I must like pizza more than carrots. Geometrically, transitive preferences imply that indifference curves cannot cross.

3. Preferences are **continuous**. This means that if a consumer prefers bundle A to bundle B, and if bundle C is only infinitesimally far away from bundle A, then the consumer also prefers bundle C to bundle B. What this rules out is sudden changes in preference patterns resulting from tiny changes. Geometrically, this means that indifference curves can be represented by continuous functions without breaks.

4. Preferences are **monotonic**. Another way to state this is "more is better". This just means that, starting with bundle A, if bundle B contains more of either good, then the consumer would prefer bundle B to bundle A. In other words, the commodities are "good" and not "bad". Preferences over dirty cat litter are not monotonic, since a consumer would prefer to have less dirty cat litter. Geometrically, this means two things. First, higher indifference curves (containing more of both goods) are preferred to lower indifference curves. Second, indifference curves slope downwards – the consumer likes good X, and is willing to give up some good Y in order to obtain more.

5. Preferences are **convex**. This is a way of saying that preferences satisfy the law of diminishing marginal rate of substitution. Geometrically, this means that indifference curves are convex to the origin – the MRS is high initially and then falls as the consumer obtains more of good X.

Preferences that are complete and transitive are called *rational*. Without rational preferences, it is impossible to do much of anything. Preferences that are complete, transitive, continuous, monotonic and convex are called *well-behaved*.