While Chapter 4 introduced us to a general way of thinking about tastes, Chapter 5 gets much more specific and introduces particular dimensions along which we might differentiate between tastes. In particular, we differentiate tastes based on

1. The curvature of individual indifference curves — or how quickly the MRS changes along an indifference curve;

2. The relationships between indifference curves — or how the MRS changes across indifference curves within an indifference map; and

3. Whether or not indifference curves cross horizontal or vertical axes or whether they converge to the axes.

The first of these in turn determines the degree to which consumers are willing to substitute between goods (and will lead to what we call the "substitution effect" in Chapter 7) while the second of these determines how consumer behavior responds to changes in income (and will lead to what we call the "income effect" in Chapter 7). Finally, the third category of taste differences becomes important in Chapter 6 where we will see how corner versus interior optimal solutions for a consumer emerge.

Chapter Highlights

The main points of the chapter are:

1. The degree of substitutability for a consumer at a particular consumption bundle arises from the curvature of the indifference curve at that bundle. There may be no substitutability (as in perfect complements) or perfect substitutability (perfect substitutes) or an infinite number of cases in between these extremes.
Different Types of Tastes

2. **Quasilinearity** and **Homotheticity** of tastes represent special cases that describe how indifference curves from the same map relate to one another. These properties have no direct relationship to the concept of substitutability. Tastes are quasilinear in a good $x$ if the $MRS$ only depends on the level of $x$ consumption (and not the level of other goods’ consumption). Tastes are homothetic when the $MRS$ depends only on the relative levels of the goods in a bundle.

3. Sometimes it is reasonable to assume that indifference curves only converge to the axes without ever crossing them; other times we assume that they cross the axes. When an indifference curve crosses an axis, it means that we can gain utility beyond what we have by not consuming even if we consume none of one of the goods. When indifference curves only converge to the axes, then some consumption of all goods is necessary in order for a consumer to experience utility above what she would experience by not consuming at all.

**Using the LiveGraphs**

For an overview of what is contained on the LiveGraphs site for each of the chapters (from Chapter 2 through 29) and how you might utilize this resource, see pages 2-3 of Chapter 1 of this *Study Guide*. To access the LiveGraphs for Chapter 5, click the *Chapter 5* tab on the left side of the LiveGraphs web site.

In addition to the *Animated Graphics*, *Static Graphics* and *Downloads* portions of the LiveGraphs site, this Chapter has several *Exploring Relationships* modules that illustrate the diversity of tastes that can emerge even from what appear to be very restrictive assumptions. The modules were designed for students who are covering part B of the *Microeconomics: An Intuitive Approach with Calculus* text — but I think you might find them engaging even if you are not formally doing the math. The three modules give you a chance to explore:

1. **Cobb-Douglas** tastes (which could be thought of as lying “halfway between” the extremes of perfect substitutes and perfect complements;

2. **Constant Elasticity of Substitution** tastes which allow for all degrees of substitutability that lie between the extremes; and

3. **Quasilinear** tastes.

In addition, there are some “games” that require you to determine the relationship between mathematical and graphical concepts. (We are still experimenting with the idea of such games and whether they are useful — and thus looking for feedback on those.)
5A Solutions to Within-Chapter-Exercises

Exercise 5A.1 How would the graph of indifference curves change if Coke came in 8 ounce cans and Pepsi came in 4 ounce cans?

Answer: The indifference curves would then have slope of \(-2\) instead of \(-1\) because you would be willing to trade 2 four ounce cans of Pepsi for 1 eight ounce can of Coke. For instance, the indifference curve that contains 1 can of Coke on the horizontal axis would also contain 2 cans of Pepsi on the vertical as well as half a can of Coke and 1 can of Pepsi. All those combinations contain 16 ounces of soft drink.

Exercise 5A.2 On a graph with quarters on the horizontal axis and dimes on the vertical, what might your indifference curves look like? Use the same method we just employed to graph my indifference curves for Coke and Pepsi — by beginning with one arbitrary bundle of quarters and dimes (say 4 quarters and 5 dimes) and then asking which other bundles might be just as good.

![Graph 5.1: Tastes over Dimes and Quarters](image)

Answer: Dimes are worth 10 cents while quarters are worth 25 cents. Thus, you are willing to trade 2.5 dimes for 1 quarter. At 4 quarters and 5 dimes, you have $1.50. Any other combination of dimes and quarters should be equally desirable. For instance, 15 dimes also make $1.50, as do 6 quarters. Thus, the indifference curve through the bundle (4,5) has intercept 6 on the horizontal (quarters) axis and 15 on the vertical (dimes) axis. This gives it a slope of \(-2.5\) which is in fact the rate at which we are willing to trade dimes for quarters. This (and two other) indifference curves are depicted in Graph 5.1.
Exercise 5A.3 What would my wife’s indifference curves for packs of sugar and glasses of iced tea look like if she required 2 instead of one packs of sugar for each glass of iced tea?

Answer: The corners of the indifference curves would now occur at bundles with twice as much sugar as iced tea. For instance, 1 glass of iced tea and 2 packets of sugar make a complete beverage, and no additional sugar and no additional iced tea will make her better off unless she gets more of both. This gives us the indifference curve labeled “1” in Graph 5.2. Similarly, 2 glasses of iced tea and 4 packets of sugar make 2 complete beverages, giving the corner of the indifference curve labeled “2”.

Exercise 5A.4 Suppose I told you that each of the indifference maps graphed in Graph 5.3 corresponded to my tastes for one of the following sets of goods, which pair would you think corresponds to which map? Pair 1: Levi Jeans and Wrangler Jeans; Pair 2: Pants and Shirts; Pair 3: Jeans and Dockers pants.

Answer: To answer this, we should ask which of the pairs represents goods that seem most substitutable for one another. I would think that would be Pair 1 since that includes two different types of jeans (which many of us probably can’t even tell apart easily). Thus, I would think that panel (a) represents Pair 1. We could then ask which of the three pairs represent goods that are most complementary (or least substitutable). Of the remaining pairs, pants and shirts seems less substitutable than jeans and Dockers pants. Thus Pair 2 — pants and shirts — would correspond to panel (c) where there is the least substitutability between the goods. This leaves panel (b) for Pair 3 — Jeans and Dockers pants.

Exercise 5A.5 Are my tastes over Coke and Pepsi as described in Section 5A.1 homothetic? Are my wife’s tastes over iced tea and sugar homothetic? Why or why not?
Answer: Yes, both are homothetic. Homothetic tastes are tastes such that the MRS is the same along any ray from the origin. For perfect substitutes like Coke and Pepsi, the MRS is the same everywhere — which means it is certainly the same along any ray from the origin. For perfect complements like sugar and iced tea, it is easy to also see that the slope of the indifference curves does not change along any ray from the origin. Below the 45 degree line (when one pack of sugar goes with one iced tea), the indifference curve is flat along any ray from the origin; above the 45 degree line, the indifference curve is vertical along any ray from the origin. On the 45 degree line, there is no slope since this is where all the corners of the indifference curve lie. (Since the slope is technically undefined for parts of the indifference map for perfect complements, you can think of this instead as the limit of a sequence of indifference maps that graphs increasingly complementary goods — with each of the maps in the sequence having the characteristic that the MRS is unchanged along any ray from the origin.)

Exercise 5A.6 Are my tastes over Coke and Pepsi as described in Section 5A.1 quasilinear? Are my wife’s tastes over iced tea and sugar quasilinear? Why or why not?

Answer: Tastes are quasilinear in the good on the horizontal axis if the MRS is unchanged along any vertical line emanating from the horizontal axis. (Alternatively, tastes are quasilinear in the good on the vertical axis if the MRS is unchanged along any horizontal line emanating from the vertical axis.) For perfect substitutes like Coke and Pepsi, the MRS is the same everywhere — which means it is certainly the same along any vertical or horizontal line. Thus, perfect substitutes are quasilinear in both goods. Perfect complements like tea and sugar, on the other hand, are not quasilinear in either good. Along any vertical line emanating from the horizontal axis, the indifference curve at some point changes from being horizontal to vertical. (The reverse is true for any horizontal line emanating from the vertical axis). You can also again think of the indifference maps that come closer and closer to those of perfect complements and treat perfect complements as the limiting case. For all maps that approach those of perfect complements, the slopes of indifference curves change along vertical and horizontal lines. Thus neither of the goods is quasilinear.

Exercise 5A.7 Can you explain why tastes for perfect substitutes are the only tastes that are both quasilinear and homothetic?

Answer: Quasilinearity implies that the MRS does not change along any vertical line emanating from the horizontal axis (or along any horizontal line emanating from the vertical axis). Homotheticity implies that the MRS is constant along any ray from the origin. Consider any vertical line emanating from the horizontal axis. All rays emanating from the origin pass through that line at some point. So if the MRS has to be the same along the vertical line and it has to be the same along rays from the origin, it must be that the MRS is the same everywhere. (The same is true if we instead considered a horizontal line emanating from the vertical axis when
Different Types of Tastes

the good on the vertical axis is quasilinear). And the only tastes for which the \( MRS \) is the same everywhere are those of perfect substitutes.

**Exercise 5A.8** True or False: Quasilinear goods are never essential.

**Answer:** True — or at least almost true. Indifference curves for quasilinear goods (almost always) cross the vertical and horizontal axes. You can think of it this way: if either good was essential — i.e. if the indifference curves did not cross one of the axes, then it must be that they are converging to that axis. If that axis is the vertical axis, then we can draw a vertical line close to the axis and, since all indifference curves are converging, it can't be that the \( MRS \)'s are the same along the vertical line. Similarly, if that axis is the horizontal axis, then converging indifference curves cannot (at least at some point) have the property that they have the same \( MRS \) on a vertical line in the graph. The only reason for the “almost” caveat is the following: Suppose the good on the horizontal axis is a “neutral” good in the sense that you do not care one way or another how much of the good you have — more simply keeps you just as well off as less. The indifference curves would then be horizontal lines — lines that cross the vertical axis but not the horizontal axis. This would make the good on the vertical axis essential (while making the good on the horizontal axis not essential). And the tastes would be quasilinear in the sense that the \( MRS \) is the same everywhere. But this is an extreme case — if you add even a slight slope to the indifference curves, they will again cross the horizontal axis (assuming that good is quasilinear) — which would again make the good on the vertical axis non-essential.

**End of Chapter Exercises**

**Exercise 5.4**

Suppose two people want to see if they could benefit from trading with one another in a 2-good world.

In each of the following cases, determine whether trade might benefit the two individuals:

(a) As soon as they start talking with one another, they find that they own exactly the same amount of each good as the other does.

**Answer:** This should in general not keep them from being able to gain from trading with one another as long as their tastes differ at the margin at the bundle they own. What matters for gains from trade is whether there are differences in the two individual's \( MRS \) at the bundle they currently own.

(b) They discover that they are long-lost twins who have identical tastes.

**Answer:** Again, that should not generally keep them from being able to trade with one another, at least as long as they don't currently own the same bundle. People with the same map of indifference curves will typically have different \( MRS \)'s when they own different bundles — and it is this difference in tastes at the margin that may arise even if people have the same map of indifference curves.

(c) The two goods are perfect substitutes for each of them — with the same \( MRS \) within and across their indifference maps.

**Answer:** In this case, there is no way to gain from trade — because no matter what bundle each of the individuals currently owns, their \( MRS \) is the same across the two individuals.
(d) They have the same tastes, own different bundles of goods but are currently located on the same indifference curve.

Answer: As long as averages are better than extremes, they will be able to trade toward a more "average" bundle and thus will both benefit from trade.

Exercise 5.6

Everyday Application: Thinking About Old Age. Consider two individuals who take a very different view of life — and consider how this shapes their tastes over intertemporal tradeoffs.

Jim is a 25 year-old athlete who derives most of his pleasure in life from expensive and physically intense activities — mountain climbing in the Himalayas, kayaking in the Amazon, bungee jumping in New Zealand, Lion safaris in Africa and skiing in the Alps. He does not look forward to old age when he can no longer do this and plans on getting as much fun in early on as he can. Ken is quite different — he shuns physical activity but enjoys reading in comfortable surroundings. The more he reads, the more he wants to read and the more he wants to retreat to luxurious libraries in the comfort of his home. He looks forward to quiet years of retirement when he can do what he loves most.

(a) Suppose both Jim and Ken are willing to perfectly substitute current for future consumption — but at different rates. Given the descriptions of them, draw two different indifference maps and indicate which is more likely to be Jim’s and which is more likely to be Ken’s.

Answer: Panel (a) of Graph 5.3 illustrates two indifference maps in one graph — with Jim’s indifference curves in solid lines and Ken’s in dashed lines. Since Jim is more interested in focusing his consumption now, his \( MRS \) is larger in absolute value — i.e. he is willing give up more future consumption for current consumption.

Graph 5.3: Jim and Ken’s Intertemporal Tastes

(b) Now suppose neither Jim nor Ken are willing to substitute at all across time periods. How would their indifference maps differ now given the descriptions of them above?

Answer: Panel (b) illustrates the case where they are not willing to substitute across time — with Jim’s indifference curves again dashed and Ken’s solid. Even though they are not willing to substitute across time, knowing that Jim wants to consume more now while Ken wants to postpone tells us where the corners of the indifference curves are relative to one another.

(c) Finally, suppose they both allowed for some substitutability across time periods but not as extreme as what you considered in part (a). Again, draw two indifference maps and indicate which refers to Jim and which to Ken.
Different Types of Tastes

Answer: These are now illustrated in panel (c) — with indifference curve similar to those in (b) except that we add some curvature to allow for some (though not complete) substitutability.

(d) Which of the indifference maps you have drawn could be homothetic?

Answer: The indifference maps in (a) are definitely homothetic (since they have the same MRS within each map. The others can certainly be homothetic. In panel (b), they are in fact clearly drawn as homothetic since the corners of the indifference curves are drawn along rays from the origin. The same could be true for panel (c).

(e) Can you say for sure if the indifference maps of Jim and Ken in part (c) satisfy the single crossing property (as defined in end-of-chapter exercise 4.9)?

Answer: You can’t say for sure. The way they are drawn in panel (c), it certainly seems like the single crossing property might hold. If the indifference maps are close to those of perfect complements, the single crossing property will, in fact, hold. But you can also imagine starting with the indifference maps in panel (a) and bending them slightly — thus creating two points at which indifference curves from the two maps cross one another.

Conclusion: Potentially Helpful Reminders

1. Keep in mind the distinction between how the MRS changes along an indifference curve (which tells us about substitutability) and how the MRS changes across the indifference map (which leads to ideas like homotheticity and quasilinearity).

2. The idea of substitutability will become critical in Chapter 7 when we introduce substitution effects (which will depend only on the shape of an indifference curve). The ideas of homotheticity and quasilinearity become important as we introduce income effects (in Chapter 7) — which will be measured across an indifference map (rather than along an indifference curve).

3. Extremes like perfect substitutes and perfect complements are useful to keep in mind because they make it easy to remember which way an indifference map looks if the goods are relatively more substitutable as opposed to relatively more complementary and vice versa.

4. Special cases like homothetic and quasilinear tastes will become useful borderline cases in Chapter 7 — with homothetic tastes being the borderline case between luxury goods and necessities, and with quasilinear tastes being the borderline case between normal and inferior goods. (These terms are defined in Chapter 7.)

5. The Chapter 5 Exploring Relationship LiveGraphs — in particular those highlighted at the beginning of this chapter — are very helpful in developing intuition about the connection between math and graphs. They also give a good sense of just how many different types of tastes we can model with the tools we have developed.