ECON 111: Fall 2021

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Today, we'll discuss budget sets and indifference curves.

1. Let's suppose that you've allocated $600 to spend on e-books and physical textbooks for the semester. You are a bibliophile, and so you always prefer more books to less regardless of how many books you already have. Suppose the price of a physical book is $120 and the price of an e-book is $50.

   (a) Sketch your budget set, which consists of all combinations of e-books and physical books that you can purchase. [1]

   (b) Are you able to purchase 2 physical books and 6 e-books?

   (c) Suppose now that the price of physical books and e-books both double, but that your spending budget for books *also* doubles. How does this affect your budget set?

   (d) What would you expect the cross-price elasticity of e-books with respect to the price of physical books to be? Why?

   (e) Let's suppose that you're old-fashioned and only prefer physical books. What do your indifference curves look like?

   (f) Supposing that you only prefer physical books, what bundle of books would you buy given your prices and wealth at the start of problem 1?

   Let's suppose now that you're not so old-fashioned, but you view these goods as perfect substitutes. In particular, let's suppose that your utility function of e-books (E) and physical books (P) is given by:[2]

   $$u(E, P) = 2P + E$$

   This means that you value each physical book twice as much as each e-book.

   (g) What is your marginal utility of a physical book? What about an e-book?

   (h) What combinations of physical books and e-books give you a utility of 1? Can you sketch them? What have you just drawn?

   (i) What bundle of physical books and e-books would you purchase with the wealth and prices you had at the start of problem 1?

   (j) Now, suppose that the price of physical books decreases to $90. What bundle of physical books and e-books would you purchase with the wealth and prices you had at the start of problem 1?

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[1] For the purposes of the problems in this handout, we will assume that both physical books and e-books are divisible, so that you can purchase fractional amounts of each.

[2] It's useful to note that P and E take the roles of x_{Ph} and x_E from the solutions to previous problems. They both capture the amount of physical books and e-books that you consume.

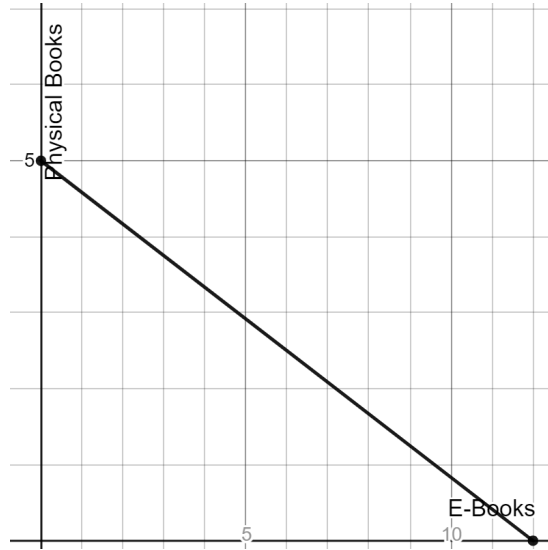1. (a) Your budget set is depicted in the following figure:

Figure 1: Your budget set

Everything between the two axes and the straight line describes the bundles that you can feasibly purchase. In particular, this is given by the set of physical books and e-books which satisfy:

$$120x_{Ph} + 50x_E \leq 600$$
$$x_{Ph}, x_E \geq 0$$

where x_{Ph} is the number of physical books you purchase and x_E is the number of e-books you purchase.

(b) Whenever you're given a bundle, all you need to do is determine whether is costs more than the amount of money that you have. In particular, the cost of 2 physical books and 6 e-books is:

$$2(120) + 6(50) = 240 + 300 = 540 < 600$$

so you can indeed afford this bundle.

(c) Since the price of each good doubles, BUT your wealth also doubles, the collection of bundles that you're able to purchase is exactly the same as in part (a). That is, your budget set doesn't change. To see why, let's write out our budget set as:

$$240x_{Ph} + 100x_E \leq 1200$$
$$x_{Ph}, x_E \geq 0$$

Dividing each side of the inequality by 2, we get:

$$120x_{Ph} + 50x_E \leq 600$$
$$x_{Ph}, x_E \geq 0$$

which is the same budget set we had from part (a).

(d) The answer to this may differ from person to person. In most cases, I would suspect that since physical books and e-books tend to serve the same purpose, physical books and e-books should be substitutes. This implies that their cross-price elasticity should be positive. When the price of one good rises, your demand for the other good should increase.

(e) When you only care about physical books, e-books provide no additional benefit for you. So, for any amount of physical books that you have, you're indifferent between receiving any amount of e-books. The following figure sketches your indifference curves in this case:
In particular, your indifference curves are horizontal. The only way to receive more utility is to obtain more physical books.
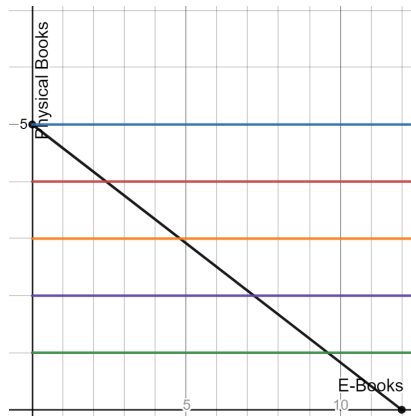
Figure 2: Indifference curves when you only value physical books

(f) Given that you only want physical books, and you'd like to purchase the bundle on the highest indifference curve, you should purchase exactly 5 physical books and 0 e-books. This will place you on the blue indifference curve in Figure 2.

(g) Given the utility function $u(E, P) = 2P + E$, we see that whenever your receive one physical book your utility rises by 2. Therefore your marginal utility of a physical book is 2. Similarly, whenever you receive an e-book, your utility rises by 1. Thus your marginal utility of an e-book is 1. *Importantly,* in general your marginal utility of another unit of a good depends on your current bundle. In this special case, your marginal utility of a physical book or e-book doesn't actually depend on your current bundle. This can hold only in this special case: *perfect substitutes*.

(h) Now, we want to know which bundles yield a utility of 1. To do this, all we need to do is consider the equation:

$$u(E, P) = 2P + E = 1$$

Now, we can sketch the curve like we would any other, with:

$$P = \frac{1}{2} - \frac{E}{2}$$

where we also need to impose $P, E \geq 0$. We have just described an indifference curve, which is sketched in the following figure:
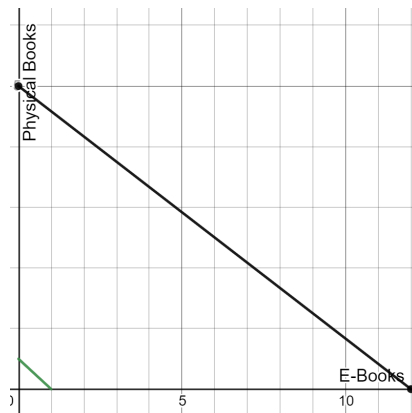

Figure 3: Bundles where your utility is 1 (green)

(i) The following figure sketches a few more indifference curves for your utility function: If you purchase only
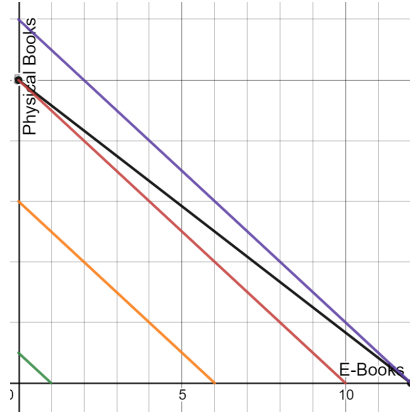

Figure 4: Caption

physical books, you will be on the red indifference curve. If you purchase only e-books, you will be on the purple indifference curve. Given that the purple indifference curve is the highest possible one that you can reach, you should purchase only e-books. The way to see this logic without actually sketching the indifference curves as follows. When you're choosing the best bundle for yourself, you should be maximizing your bang-per-buck from your purchases. This is your marginal utility divided by the price of each good. For instance, your bang-per-buck of a physical book is given by:

$$\frac{MU_{Ph}}{P_{ph}} = \frac{2}{120} = \frac{1}{60}$$

whereas your bang-per-buck for an e-book is given by:

$$\frac{MU_E}{P_E} = \frac{1}{50}$$

The important thing to notice in the case of perfect substitutes is that our marginal utilities of each good don't depend on which bundle we're purchasing. Therefore, where will in general be a single good which *always* has the better marginal utility per dollar. In this case, the marginal utility per dollar of e-books is always higher than that of a physical book. Therefore, you should always purchase e-books.

(j) The following figure describes your new budget set and the highest indifference curve that you can reach: In this case, the highest indifference curve that you can reach is the green one, which intersects your budget set at the point where you only purchase physical books. The reason is that now the bang-per-buck of a physical book is always greater than that of an e-book. Indeed, your bang-per-buck of a physical book is now:

$$\frac{MU_{ph}}{P_{ph}} = \frac{2}{90} = \frac{1}{45}$$
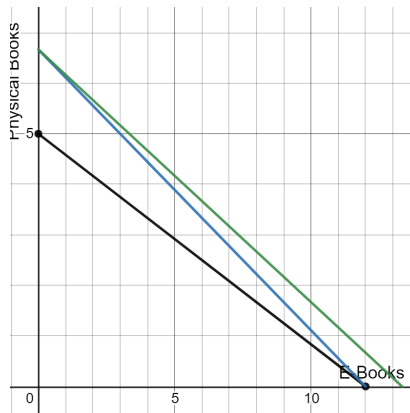

Figure 5: Your new budget set (blue) and highest indifference curve (green)

whereas your bang-per-buck of an e-book is the same as before:

$$\frac{MU_E}{P_E} = \frac{1}{50}$$

Thus, since you get more utility per dollar for a physical book, you should spend all of your money on physical books.