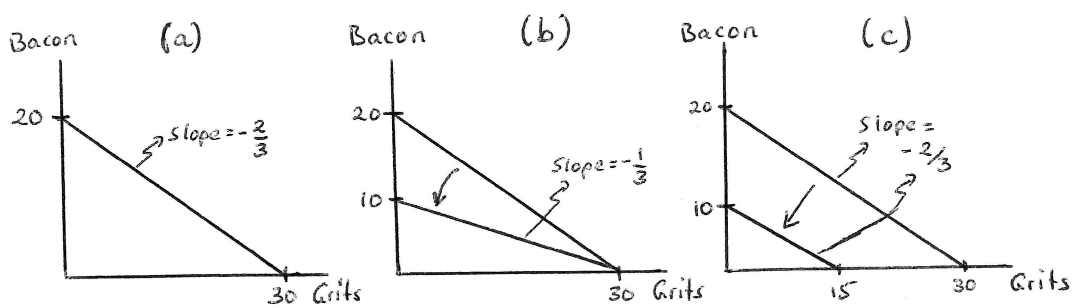
Exercise 2.1

Any good Southern breakfast includes grits (which my wife loves) and bacon (which I love). Suppose we allocate \$60 per week to consumption of grits and bacon, that grits cost \$2 per box and bacon costs \$3 per package.

A: *Use a graph with boxes of grits on the horizontal axis and packages of bacon on the vertical to answer the following:*

(a) *Illustrate my family's weekly budget constraint and choice set.*

Answer: The graph is drawn in panel (a) of Exercise Graph 2.1.



Exercise Graph 2.1 : (a) Answer to (a); (b) Answer to (c); (c) Answer to (d)

(b) *Identify the opportunity cost of bacon and grits and relate these to concepts on your graph.*

Answer: The opportunity cost of grits is equal to 2/3 of a package of bacon (which is equal to the negative slope of the budget since grits appear on the horizontal axis). The opportunity cost of a package of bacon is 3/2 of a box of grits (which is equal to the inverse of the negative slope of the budget since bacon appears on the vertical axis).

(c) *How would your graph change if a sudden appearance of a rare hog disease caused the price of bacon to rise to \$6 per package, and how does this change the opportunity cost of bacon and grits?*

Answer: This change is illustrated in panel (b) of Exercise Graph 2.1. This changes the opportunity cost of grits to 1/3 of a package of bacon, and it changes the opportunity cost of bacon to 3 boxes of grits. This makes sense: Bacon is now 3 times as expensive as grits — so you have to give up 3 boxes of grits for one package of bacon, or 1/3 of a package of bacon for 1 box of grits.

(d) *What happens in your graph if (instead of the change in (c)) the loss of my job caused us to decrease our weekly budget for Southern breakfasts from \$60 to \$30? How does this change the opportunity cost of bacon and grits?*

Answer: The change is illustrated in panel (c) of Exercise Graph 2.1. Since relative prices have not changed, opportunity costs have not changed. This is reflected in the fact that the slope stays unchanged.

B: *In the following, compare a mathematical approach to the graphical approach used in part A, using x_1 to represent boxes of grits and x_2 to represent packages of bacon:*

(a) *Write down the mathematical formulation of the budget line and choice set and identify elements in the budget equation that correspond to key features of your graph from part 2.1A(a).*

Answer: The budget equation is $p_1x_1 + p_2x_2 = I$ can also be written as

$$x_2 = \frac{I}{p_2} - \frac{p_1}{p_2}x_1. \tag{2.1.i}$$

With $I = 60$, $p_1 = 2$ and $p_2 = 3$, this becomes $x_2 = 20 - (2/3)x_1$ — an equation with intercept of 20 and slope of $-2/3$ as drawn in Exercise Graph 2.1(a).

(b) *How can you identify the opportunity cost of bacon and grits in your equation of a budget line, and how does this relate to your answer in 2.1A(b).*

Answer: The opportunity cost of x_1 (grits) is simply the negative of the slope term (in terms of units of x_2). The opportunity cost of x_2 (bacon) is the inverse of that.

(c) *Illustrate how the budget line equation changes under the scenario of 2.1A(c) and identify the change in opportunity costs.*

Answer: Substituting the new price $p_2 = 6$ into equation (2.1.i), we get $x_2 = 10 - (1/3)x_1$ — an equation with intercept of 10 and slope of $-1/3$ as depicted in panel (b) of Exercise Graph 2.1.

(d) *Repeat (c) for the scenario in 2.1A(d).*

Answer: Substituting the new income $I = 30$ into equation (2.1.i) (holding prices at $p_1 = 2$ and $p_2 = 3$, we get $x_2 = 10 - (2/3)x_1$ — an equation with intercept of 10 and slope of $-2/3$ as depicted in panel (c) of Exercise Graph 2.1.

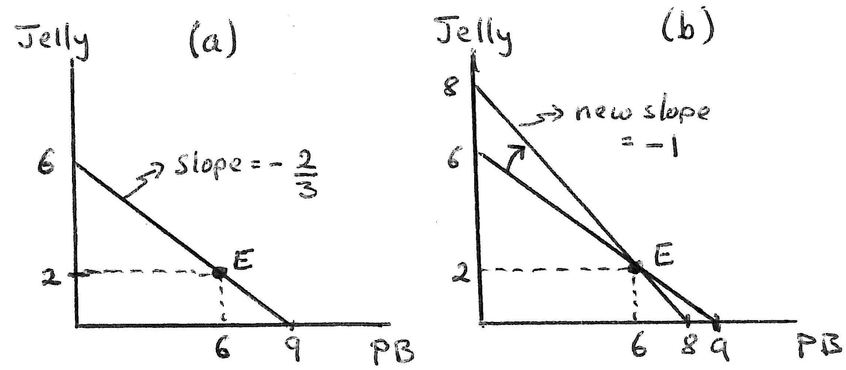
Exercise 2.2

Suppose the only two goods in the world are peanut butter and jelly.

A: *You have no exogenous income but you do own 6 jars of peanut butter and 2 jars of jelly. The price of peanut butter is \$4 per jar, and the price of jelly is \$6 per jar.*

(a) *On a graph with jars of peanut butter on the horizontal and jars of jelly on the vertical axis, illustrate your budget constraint.*

Answer: This is depicted in panel (a) of Exercise Graph 2.2. The point E is the endowment point of 2 jars of jelly and 6 jars of peanut butter (PB). If you sold your 2 jars of jelly (at a price of \$6 per jar), you could make \$12, and with that you could buy an additional 3 jars of PB (at the price of \$4 per jar). Thus, the most PB you could have is 9, the intercept on the horizontal axis. Similarly, you could sell your 6 jars of PB for \$24, and with that you could buy 4 additional jars of jelly to get you to a maximum total of 6 jars of jelly — the intercept on the vertical axis. The resulting budget line has slope $-2/3$, which makes sense since the price of PB (\$4) divided by the price of jelly (\$6) is in fact $2/3$.



Exercise Graph 2.2 : (a) Answer to (a); (b) Answer to (b)

(b) *How does your constraint change when the price of peanut butter increases to \$6? How does this change your opportunity cost of jelly?*

Answer: The change is illustrated in panel (b) of Exercise Graph 2.2. Since you can always still consume your endowment E, the new budget must contain E. But the opportunity costs have now changed, with the ratio of the two prices now equal to 1. Thus, the new budget constraint has slope -1 and runs through E. The opportunity cost of jelly has now fallen from $3/2$ to 1. This should make sense: Before, PB was cheaper than jelly and so, for every jar of jelly you had to give up more than a jar of peanut butter.

Now that they are the same price, you only have to give up one jar of PB to get 1 jar of jelly.

B: *Consider the same economic circumstances described in 2.2A and use x_1 to represent jars of peanut butter and x_2 to represent jars of jelly.*

(a) *Write down the equation representing the budget line and relate key components to your graph from 2.2A(a).*

Answer: The budget line has to equate your wealth to the cost of your consumption. Your wealth is equal to the value of your endowment, which is $p_1e_1 + p_2e_2$ (where e_1 is your endowment of PB and e_2 is your endowment of jelly). The cost of your consumption is just your spending on the two goods — i.e. $p_1x_1 + p_2x_2$. The resulting equation is

$$p_1e_1 + p_2e_2 = p_1x_1 + p_2x_2. \tag{2.2.i}$$

When the values given in the problem are plugged in, the left hand side becomes $4(6) + 6(2) = 36$ and the right hand side becomes $4x_1 + 6x_2$ — resulting in the equation $36 = 4x_1 + 6x_2$. Taking x_2 to one side, we then get

$$x_2 = 6 - \frac{2}{3}x_1, \tag{2.2.ii}$$

which is exactly what we graphed in panel (a) of Exercise Graph 2.2 — a line with vertical intercept of 6 and slope of $-2/3$.

(b) *Change your equation for your budget line to reflect the change in economic circumstances described in 2.2A(b) and show how this new equation relates to your graph in 2.2A(b).*

Answer: Now the left hand side of equation (2.2.i) is $6(6) + 6(2) = 48$ while the right hand side is $6x_1 + 6x_2$. The equation thus becomes $48 = 6x_1 + 6x_2$ or, when x_2 is taken to one side,

$$x_2 = 8 - x_1. \tag{2.2.iii}$$

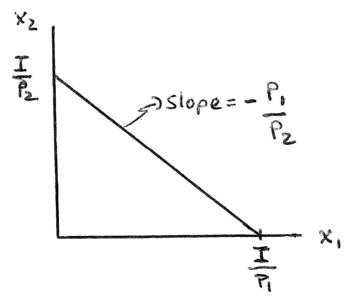
This is an equation of a line with vertical intercept of 8 and slope of -1 — exactly what we graphed in panel (b) of Exercise Graph 2.2.

Exercise 2.3

Consider a budget for good x_1 (on the horizontal axis) and x_2 (on the vertical axis) when your economic circumstances are characterized by prices p_1 and p_2 and an exogenous income level I.

A: *Draw a budget line that represents these economic circumstances and carefully label the intercepts and slope.*

Answer: The sketch of this budget line is given in Exercise Graph 2.3.



Exercise Graph 2.3 : A budget constraint with exogenous income I

The vertical intercept is equal to how much of x_2 one could by with I if that is all one bought — which is just I/p_2. The analogous is true for x_1 on the horizontal intercept. One way to verify the slope is to recognize it is the "rise" (I/p_2) divided by the "run" (I/p_1) — which gives p_1/p_2 — and that it is negative since the budget constraint is downward sloping.

(a) *Illustrate how this line can shift parallel to itself without a change in I.*

Answer: In order for the line to shift in a parallel way, it must be that the slope $-p_1/p_2$ remains unchanged. Since we can't change I, the only values we can change are p_1 and p_2 — but since p_1/p_2 can't change, it means the only thing we can do is to multiply both prices by the same constant. So, for instance, if we multiply both prices by 2, the ratio of the new prices is $2p_1/(2p_2) = p_1/p_2$ since the 2's cancel. We therefore have not changed the slope. But we have changed the vertical intercept from I/p_2 to $I/(2p_2)$. We have therefore shifted in the line without changing its slope.

This should make intuitive sense: If our money income does not change but all prices double, then I can by half as much of everything. This is equivalent to prices staying the same and my money income dropping by half.

(b) *Illustrate how this line can rotate clockwise on its horizontal intercept without a change in p_2.*

Answer: To keep the horizontal intercept constant, we need to keep I/p_1 constant. But to rotate the line clockwise, we need to increase the vertical intercept I/p_2. Since we can't change p_2 (which would be the easiest