

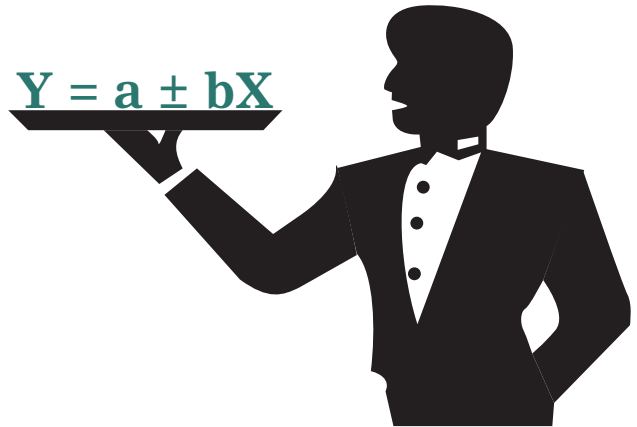
All Relationships Have Rules

Recipe

Ingredients

vertical axis
horizontal axis
2 variables
Y-intercept
slope
+ or - sign
= sign

$$Y = a \pm bX$$



Directions

Put the equal sign on a page.
Put the variable that is measured on the vertical axis on the left hand side of the = sign by itself.
Put the Y-intercept right after the = sign.
Put the + or - sign next.
Put the slope after the \pm sign.
Put the variable measured on the horizontal axis on the right hand side of the slope.
Now you have the *perfect equation!*

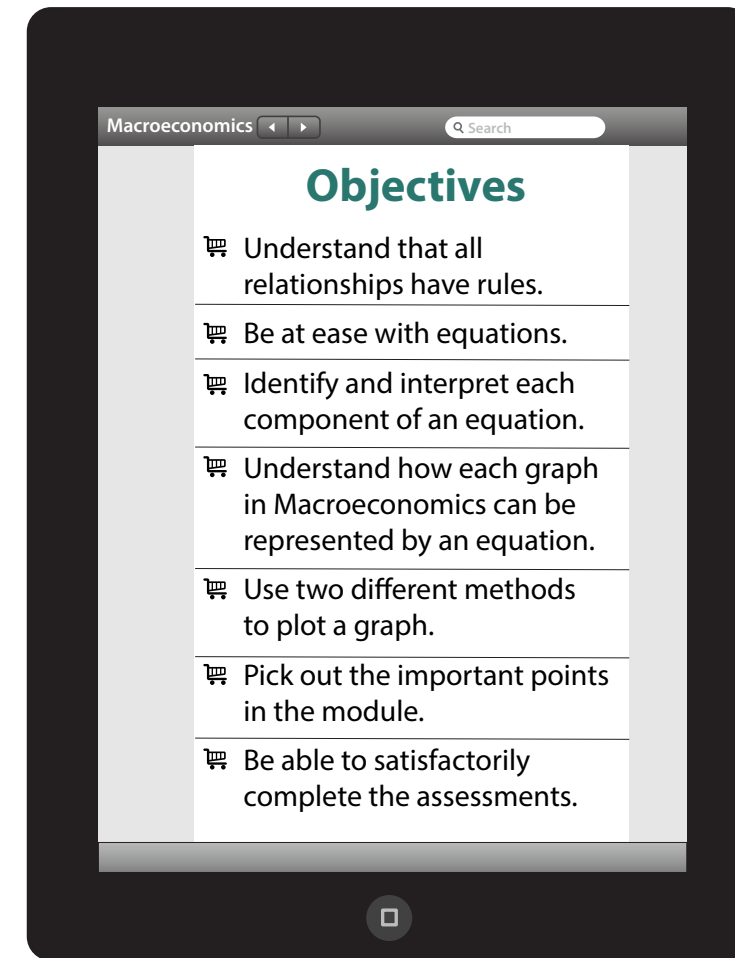
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Introduction to Equations

How do you feel about numbers? Would you prefer to use words? Does the thought of an equation make you want to close the book? Do you wonder why you even have to use them in Macroeconomics?

Equations are a convenient way to express precise relationships between variables. You use them every day without even realizing it. If you are late for an appointment and you call to say how late you will be arriving, you calculate the distance you have left to travel and the speed at which traffic is moving. If you are having friends over for pizza, you calculate how many slices each

person will eat and multiply it by the number of people coming over. You then determine how many slices are in a pizza to determine how many pizzas you will have to buy.

Equations in economics are similar. We must translate the relationship between variables into mathematical language. To keep it simple, we will only be looking at linear equations (straight lines).

In Macroeconomics all equations have the same format. Regardless of the function, all the elements are always put in the same place. There are rules determining where each element of the equation goes. That is

why we say that *all relationships have rules*. Understanding these rules is the key to feeling comfortable and mastering equations.

All the equations that we will look at have corresponding graphs. Each time you see an equation, you should draw the corresponding graph to help you visualize what you are being asked to do.



Format of Linear Equations in Math

General Form

It is important to recognize that Macroeconomics does not always follow the convention in math when handling equations. Understanding how both are derived will help you understand the differences. In Macroeconomics we will only be looking at linear equations.

In math the general form of a linear equation is:
 $Ax + By = C$

For example, $2x - y = -1$, where

$$A = 2$$

$$B = -1$$

$$C = -1$$

The problem with this type of equation is that you cannot graph a line from it. Frequently, we need to graph the function in order to visualize what it looks like. We use the Slope Intercept Form to overcome this weakness.

Slope Intercept Form

The Slope Intercept Form puts the equation in a format that allows us to graph the function.

$$y = mx + b$$

With some simple algebra we can get our initial equation into this format.

Our initial equation is:

$$2x - y = -1$$

Bring $2x$ to the other side of the equal sign. It then becomes $-2x$

$$-y = -2x - 1$$

Divide both sides by -1 to get rid of the $-$ sign. If you do it to both sides of the equation, it does not change the value of the equation.

$$y = 2x + 1$$

which is in the Slope Intercept Form:

$$y = mX + b$$

where $m = 2$, which is the slope

and $b = 1$, which is the Y-intercept.



Format of Linear Equations in Macroeconomics

Slope Intercept Form

In Macroeconomics we use the Slope Intercept Form since we are interested in graphing the relationship between the variables. Maybe we should call it the Intercept Slope Form since the order of the elements in the equation is different from math.

$$Y = a \pm bX$$

Y is what is measured on the vertical axis

It may or may not be the dependent variable

It is always on the left-hand side of the equal sign by itself

a is the Y-intercept

It comes right after the equal sign

It is the value of Y when $X = 0$

It is where the graph touches the vertical axis

It could be positive or negative

If it is positive, the graph touches the vertical axis above the origin

If it is negative, the graph touches the vertical axis below the origin

b is the slope

It comes right after the Y-intercept

The sign in front of it determines if the slope is positive or negative

It is calculated using the formula $\Delta Y / \Delta X$ (rise over run) or $Y_1 - Y_2 / X_1 - X_2$

It tells us how much Y changes, if X increases by 1

For example, if the slope is 3, if X increases by 1, Y increases by 3

If the slope is $\frac{3}{4}$, if X increases by 1, Y increases by $\frac{3}{4}$

If the slope is -2 , if X increases by 1, Y decreases by 2

The slope measures marginal propensities (tendencies)

X is what is measured on the horizontal axis

It may or may not be the independent

variable

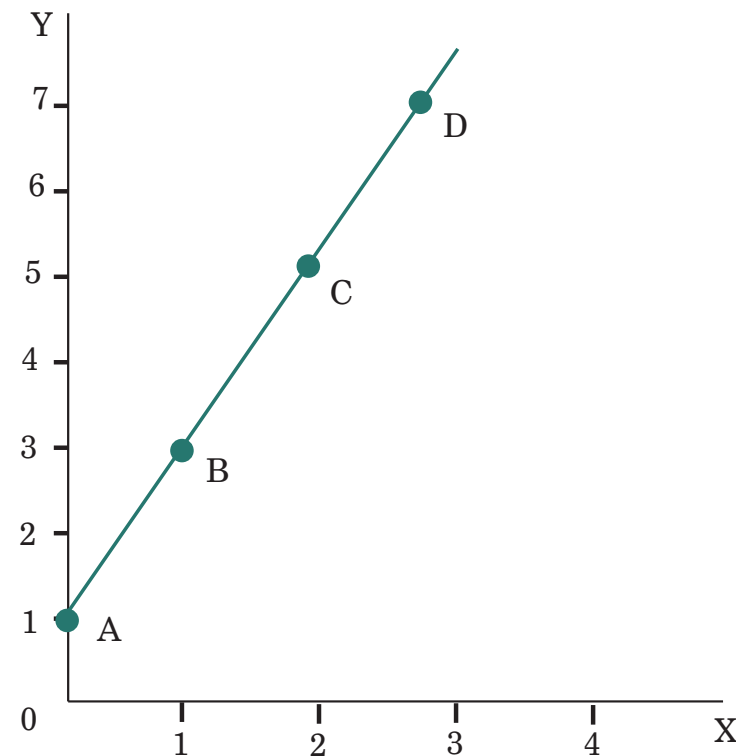


Plotting Graphs

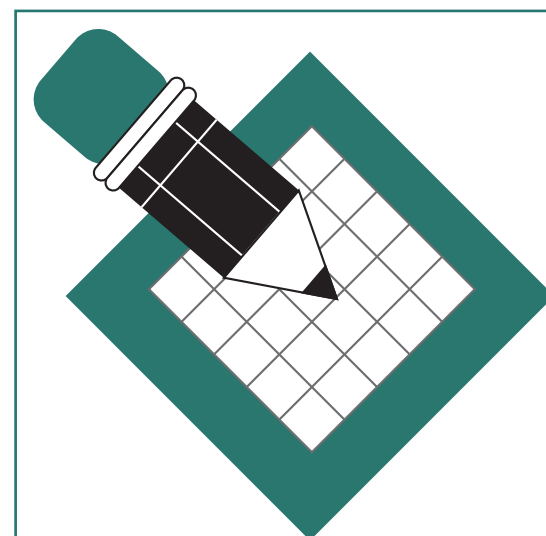
Plotting a graph helps you understand how graphs are constructed. You can use a schedule which is a table of numbers showing the relationship between the two variables to plot graphs. Using the same example, as before, the corresponding table would be the one below.

Most of the time, we are not given all the information required to plot graphs. It would also take too much time if we plotted a graph each time we needed to use one. Therefore, we will examine how to move from equations to graphs in the next section.

Points	Y	X
A	1	0
B	3	1
C	5	2
D	7	3



Go along the X axis to 0 and go up on the Y axis to 1. Label it point A.
Plot the other points using the above method.
Label each point.
Take a ruler and join all the points with a straight line.



Moving From Equations to Graphs

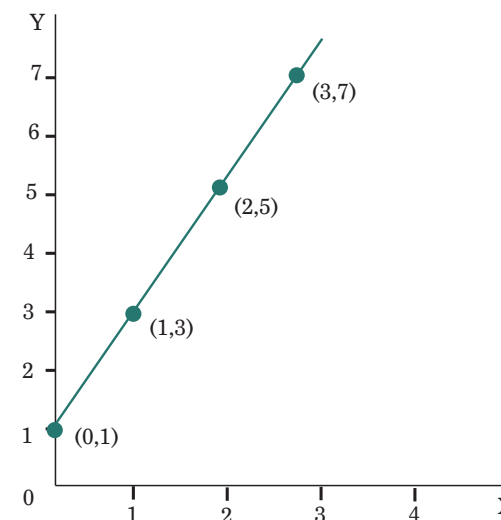
Finding a Precise Relationship

In Macroeconomics you are frequently given equations and asked to solve for something. It could be income, consumption or any other variable. It is useful to draw a graph corresponding to the equation in order to visualize the problem. We can use the slope and intercept to find the exact relationship between the two variables.

If we use the same example, the equation would be:

$Y = 1 + 2X$, where
Y-intercept = 1
the slope = 2

Our first point on the graph would be the Y-intercept (0, 1). We would go along the horizontal axis by one and up along the vertical axis by two. That would give us our second point (1, 3). We would go along the horizontal axis by one again and up along the vertical axis by two again and that would give us another point (2, 5). We would repeat the same process and get the last point (3, 7). Take a ruler and join the points and you would get the same line that you plotted on the previous page.



Using Graphs to Help Solve Equations

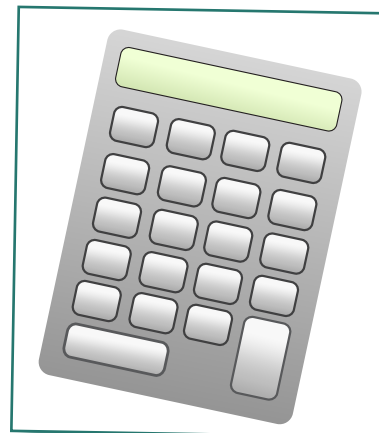
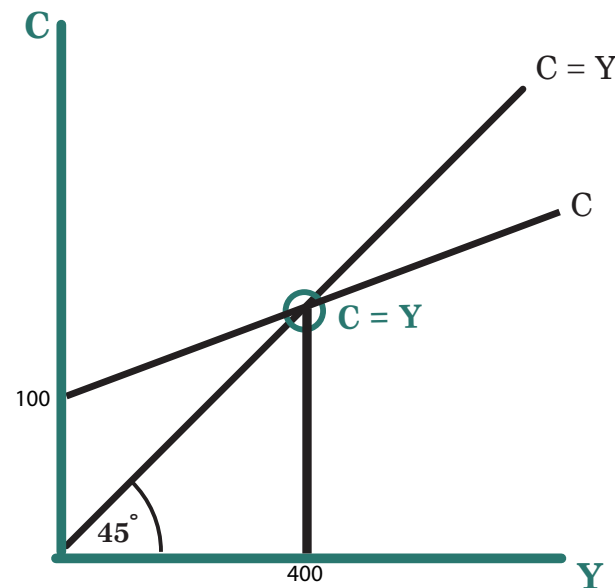
Sometimes you are given equations and are asked to solve for a specific value of a variable. In order to understand the problem, you may want to draw a graph to give you a clear idea of what the problem is asking you for. It may not be necessary to know the precise relationship between the variables but you may just want to have a general idea.

For example, you are given the consumption function $C = 100 + 0.75Y$ and you are asked to find the level of income where consumption is equal to income.

Remember that the general format of an equation in Macroeconomics is $Y = a + bX$

Therefore, C (consumption) is measured on the vertical axis
 Y (income) is measured on the horizontal axis
 100 is the Y-intercept
 0.75 is the slope

We know that $C = Y$ along each point along a 45 degree line.
 Draw a 45 degree line, labeling the vertical axis (C) consumption and the horizontal axis Y (income). Indicate $C = Y$ at the top of the graph.



We also know from the previous module, that we would never see a 45 degree line by itself. It would always be with another function. Therefore, we put in the consumption function. Since the Y-intercept is 100, the consumption function will cut the vertical axis at 100. Since the slope is a positive number, we know that the consumption function will move up from left to right.

Looking at the graph, it is clear that we are looking for the intersection of the two lines. We see that we need to set the consumption function equal to the 45 degree line and solve for Y.

The equation for the consumption function is
 $C = 100 + 0.75Y$
 and the equation for the 45 degree line is
 $Y = C$.

We refer to the 45 degree line as Y, since we can't compare C with C.

When we set $Y = C$, we get
 $Y = 100 + 0.75Y$

We then solve for Y

Bring 0.75Y on the other side of the equal sign to keep the Ys together
 It becomes negative since we brought it on the other side of the equal sign

$$Y - 0.75Y = 100$$

$$Y \text{ is equal to } 1Y$$

$$1Y - 0.75Y = 0.25Y$$

$$0.25Y = 100$$

Divide both sides by 0.25 and we get

$$Y = 400$$

When income is 400, consumers spend all of it.

Having an idea of what the graphs looked like helped us to visualize the problem.



Slope Intercept Form: Math versus Economics

Students often get confused with the general format of an equation in Macroeconomics because it is not the same as what is used in math. The key to mastering equations in Macroeconomics is to remember that math uses different variables to represent the Y-intercept and the slope. In math **m** is used to represent the slope, whereas, in economics **b** is used. In math **b** is used to represent the Y-intercept, whereas, in economics **a** is used.

The order in which each element is placed is also different in math and in Macroeconomics. In math the slope comes before the Y-intercept and in Macroeconomics the slope comes after the Y-intercept.

Math

$$Y = mX \pm b$$

Y = what is measured on the vertical axis and is the dependent variable

m = slope

X = what is measured on the horizontal axis and is the independent variable

b = the Y-intercept

Economics

$$Y = a \pm bX$$

Y = what is measured on the vertical axis and is not always the dependent variable

a = the Y-intercept

b = slope

X = what is measured on the horizontal axis and is not always the independent variable



Summary

MATH

Slope Intercept Form

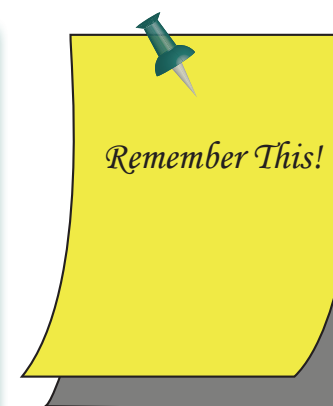
$$Y = mX \pm b$$

Y = the dependent variable
what is measured on the
vertical axis

m = slope

X = is the independent variable
what is measured on the
horizontal axis

b = Y-intercept



ECONOMICS

Slope Intercept Form

$$Y = a \pm bX$$

Y = what is measured on the
vertical axis

a = Y-intercept

b = slope

X = what is measured on the
horizontal axis

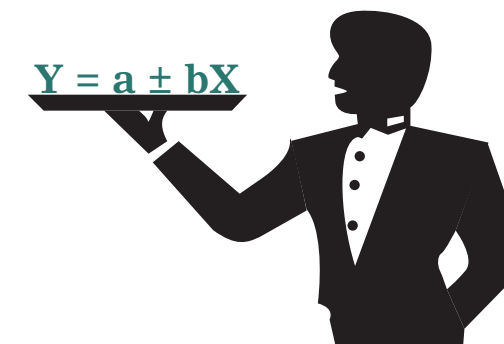
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vertical axis
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2 variables
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+ or - sign
= sign

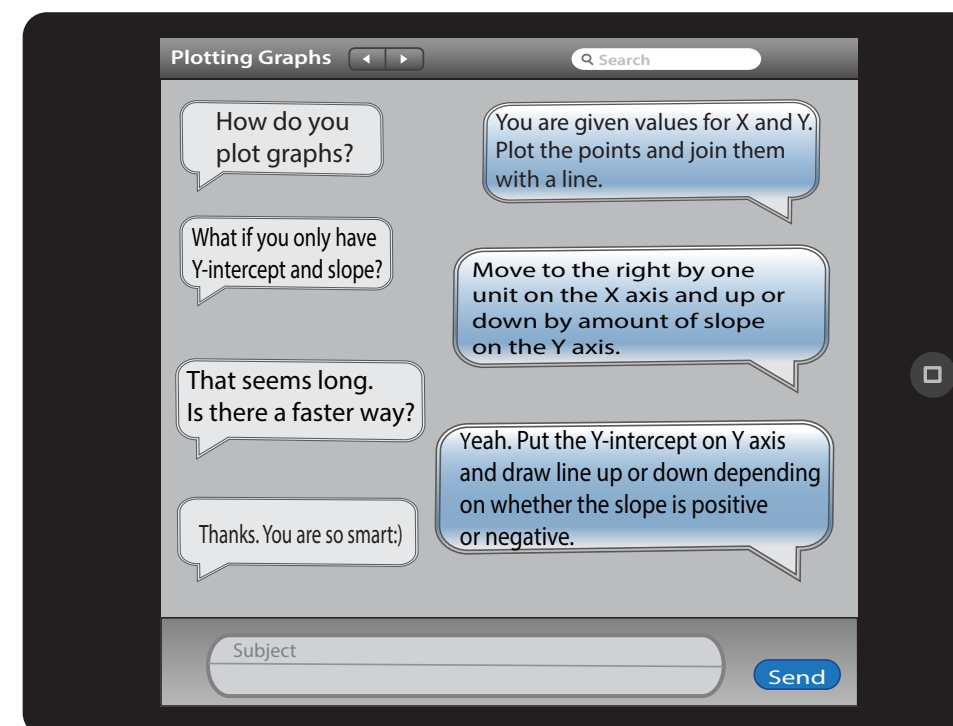
$$Y = a \pm bX$$



Directions

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Put the Y-intercept right after the = sign.
Put the + or - sign next.
Put the slope after the ± sign.
Put the variable measured on the horizontal axis on the right hand side of the slope.
Now you have the *perfect equation!*

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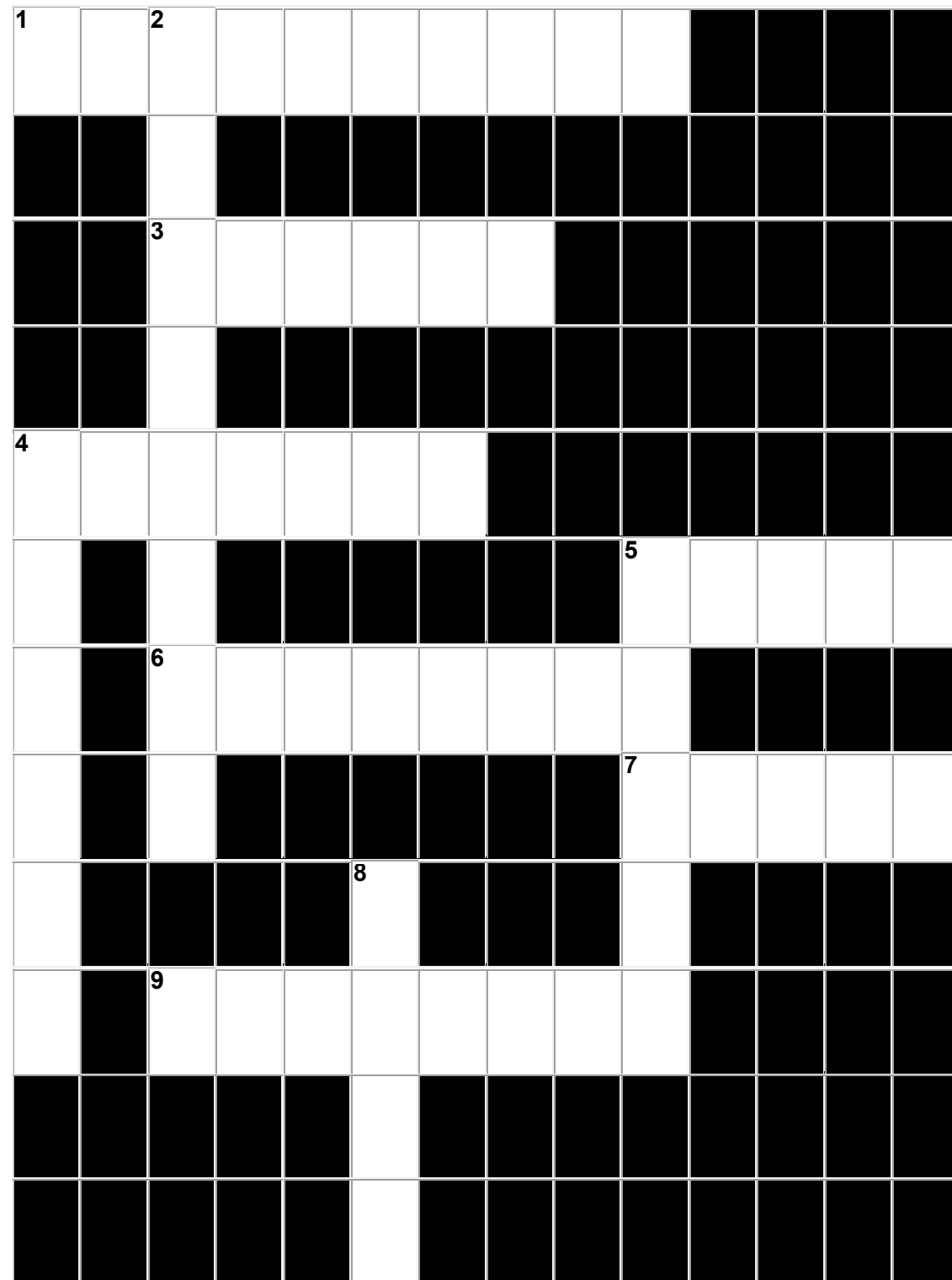
Assessments

- 1 Highlight important points**
Reread the module and highlight the important points. You don't have to do it all at once. Do one section at a time.
- 2 Explain two different formats of a linear equation**
Explain the two different formats of a linear equation. Why do we use the Slope Intercept Form in Macroeconomics? Illustrate and explain how the Slope Intercept Form used in Macroeconomics differs from math.
- 3 Plot the savings function**
If the slope of the savings function is 0.25 and the Y-intercept is -100, plot the savings function. Explain in detail how you derived your savings function.
- 4 Apply the General Form of an equation to your everyday life**
Express something in your everyday life in the General Form of an equation.
- 5 Use graphs to solve for the equilibrium level of income**
The equation for the aggregate expenditure function = $600 + 0.70Y$.
Use graphs to help you solve for the equilibrium level of income. Explain in detail how you derived your answer.

The answers are available online. You may print them for future reference.



Crossword Puzzle



Clues

Across:

- 1 In Macroeconomics, using the Slope Intercept Form, what comes after the equal sign?
- 3 What should you always use to help you solve equations?
- 4 In math and in Macroeconomics the slope is represented by different
- 5 If you are given the Y-intercept, what else would you need in order to determine a precise relationship between two variables?
- 6 The variable that is placed on the left hand side of the equal sign is measured on which axis?
- 7 In Macroeconomics and in math each element is placed in a different
- 9 We always refer to the 45 degree line as the other

Down:

- 2 If a graph starts below the origin, the Y-intercept is
- 4 All the equations we will be looking at in Macroeconomics are
- 5 In math, using the Slope Intercept Form, what comes after the equal sign?
- 8 What in front of the slope determines whether the graph is upward sloping or downward sloping?

