HOW MATHS SPEAKS TO ECONOMICS

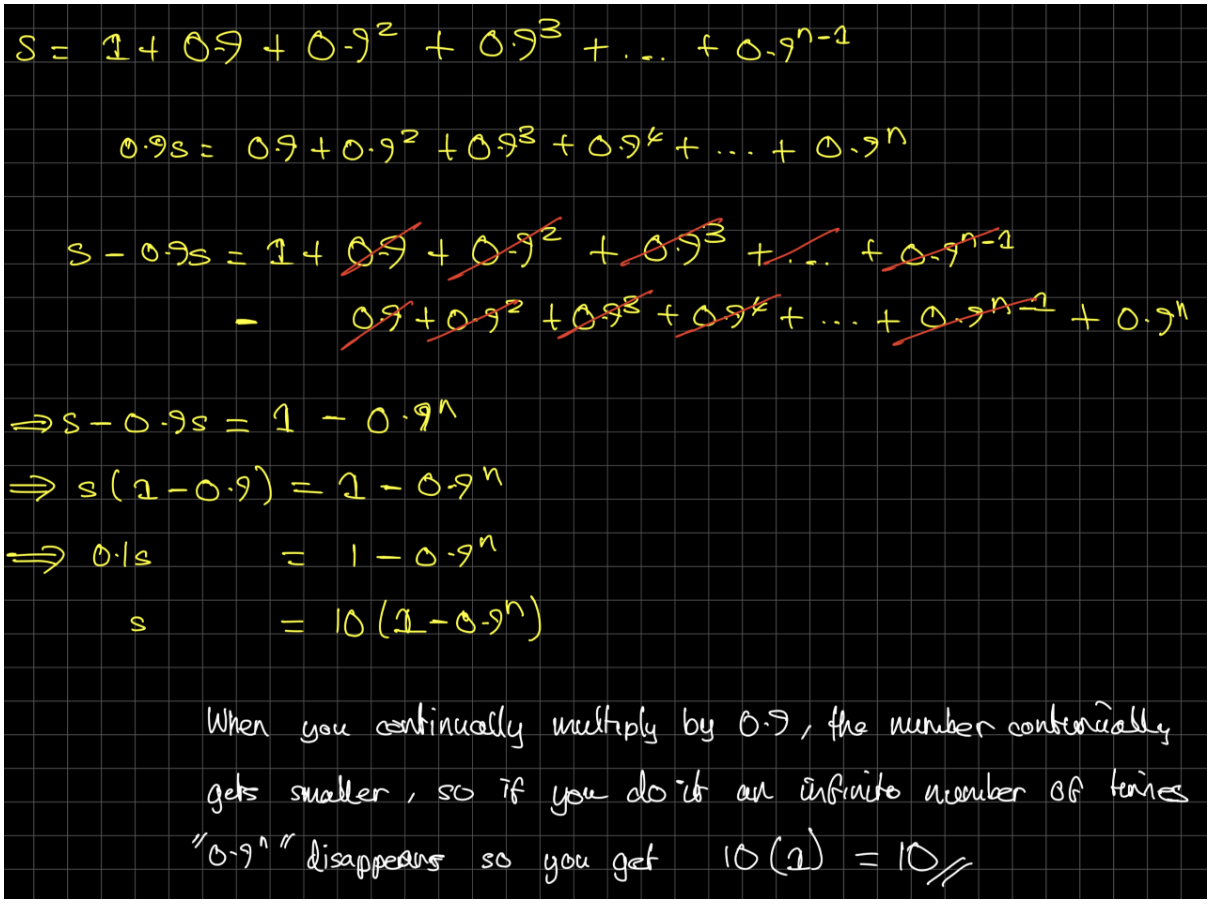
Introduction

An economy is any system that tries to solve the economic problem or the problem of scarcity. At this point, you are wondering "what is the economic problem? "Well Humans have infinite wants but scarce resources (e.g., of limited resources are: raw materials, money, and time) therefore sometimes we struggle to get what we want. For an economist to visualize the Economic problem he needs a model and an "economic model". We are a growing population of almost 8 billion people and we live on a planet where resources may seem unlimited but are not. On earth, there are approximate: 3,400,000,000,000 trees, 1650000000000 barrels of natural oil, more than 230000000000 tons of iron and 1,260,000,000,000,000,000,000 litres of water. These are big numbers and hard to manage therefore economists like to simplify a theory by using smaller and more simplified versions of facts to model a theory as they like to use the word "ceteris paribus" which means "All other things held constant". Economics is a vast subject there is the history of economics, the social implications, the monetary policy of different countries or even the environmental aspect of it as you study Economics you will quickly realize that you cannot understand it unless you put it into a mathematical term and everything will be clearer as maths allows us to break down a problem even further. These are some interactive scenarios in which you can use maths in economics.

Money multiplier

In this section we will be exploring how after you make 1£ it is worth 10£ in the economy with the money multiplier

Let us imagine you are the king of a country called “Mathematics” this is a new Ireland full of resources and with a population of 100 000 people. You decide to develop an economic system in your country by starting with a bank and you create a currency called “factorial” and is represented by this symbol “!” you soon realize that the transaction system is not as simple as people leaving money in the bank and then bye, the bank must have a system and balance in which loans and deposits must have a specific pattern. You discover the money multiplier which refers to how an initial deposit can lead to a bigger final increase in the total money supply. To explain the money multiplier mathematically we will create a simplified model."Ceteris paribus" imagine your bank creates 1! in “paper money”. the bank must and has to keep 10 % of deposits. this means that the bank can lend 90% of that money or 0.90! As the money is lent it enters the economy and as people buy goods and services with that money or use it to invest in the general economy it will eventually be put back in banks. And the bank will eventually loan or lend 90% of that 0.90! which will be 0.81! that is put in the economy this cycle will repeat so if we wanted to calculate the total loan which is “1+0.9+(0.9) ^2+(0.9) ^3+...” we would use a subject in calculus called Geometric series.



banks can generate through the money multiplier 10 dollars just in loans from the 1 dollar created. Maths can help us break down the problem into its foundation to give us a better understanding of specific economic problems rather than just memorising formulas. With geometric series, we were able to understand how banks' balance loans and deposits to create equilibrium within our economy.

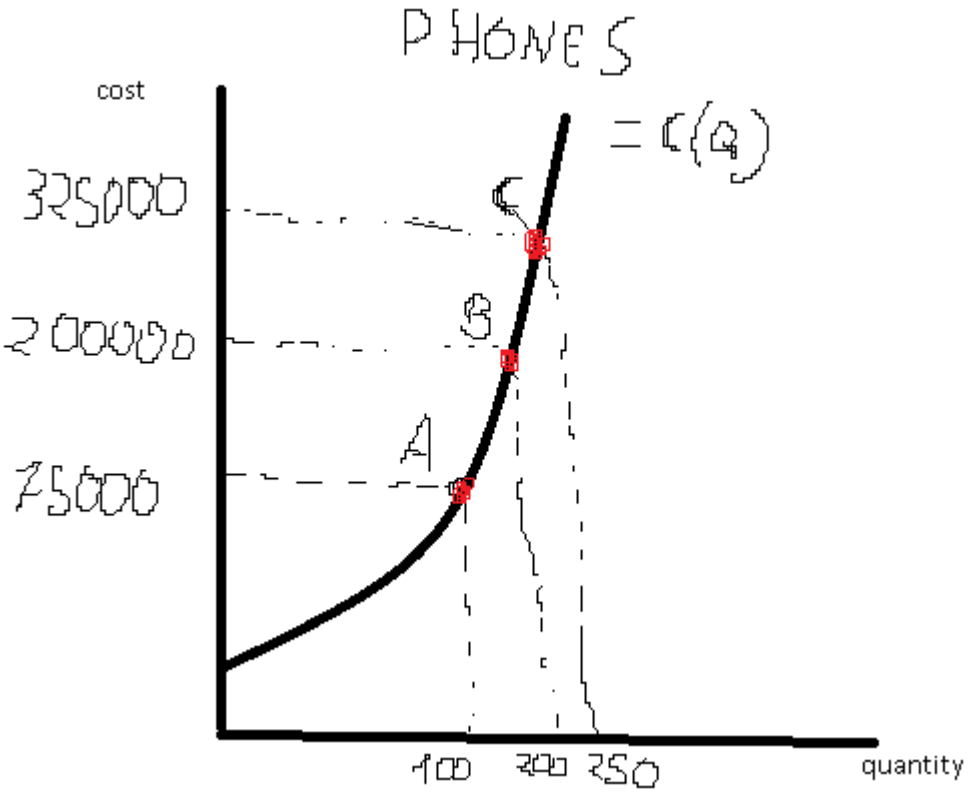
Using calculus to start a firm

Let us imagine your country “Mathematics” needs a new source of income. You decide that your country is going to sell phones as now is one of the most profitable businesses. “Mathematics” is a small Island therefore it does not have many resources to produce that many phones. You start the business and at first, is going well but then you notice that your revenue is going downhill and you are close to being bank robbed. You decide to investigate the problem and discover the cost of production phones per unit increases by a disproportionate amount per additional unit made. The top economists of your country decide to simplify your theory on a graph to show the relationship between the cost of production(y-axis) and the number of phones your country can produce (x-axis).

Explaining the graph

In the graph, we can see that on the y axis there is the cost of production and on the x-axis is the number of phones that can be produced. We define their relationship (the line) with a function “c(q)” and we give it a quadratic equation such as:

$c(q) = x^2 + 2x + 17$ and then we draw a graph for it. In Economics we do not deal with such things as negative quantity or negative costs so we can use the graph at the point where both the y axis and x-axis are positive. (The diagram is obviously not accurate but is meant to put a point across) Then we highlight 3 specific coordinates of the graph A-B-C such as A= (100,75 000), B= (200,200 000), C= (250,325 000).



now that we have our 3 points, we can investigate the problem even further. As you were confident about your theory you decide to prove it mathematically. To prove your theory, you need to find the % change of the cost of production per additional good created, in mathematical terms the change of the gradient from A to B compared to the change in a gradient from B to C to find the relationship between the cost of production and quantity. To prove our theory, we will increase the cost by 125 000£ each time from A to B and from B to C to make the experiment fair. To calculate the gradient, we will need Calculus. We start by differentiating the function "c(q)" such as $c(q) = x^2 + 2x + 17$ turns into $\frac{d}{dx} = 2x + 2$ then we find the gradient by substituting the x coordinate to the equation such as $2(100)+2$ =202 $2(200)+2$ =402 $2(250)+2$ =502

Then we collect the gradients=M such as MA=202, MB=402, MC=502 then we calculate the % change from MA to MB $\frac{402-202}{202} \cdot 100$ =99%(3sf) and then from MB to MC $\frac{502-402}{402} \cdot 100$ =24.9%(3sf) we compare our two answers we can see that the % change decreases from 99% to a staggering 24% this demonstrates that as the cost of

production increases, we are able to buy less additional goods than before. In economics, we call the function $\frac{d}{dx}$ or the gradient the marginal cost. The marginal cost is the rate at which cost is increasing for that incremental unit of a good. The results of our theory make sense because the cost of production increases, as raw materials (to make a phone), are harder to find as you use them, they become scarce over time we call this the economic problem when humans have infinite wants and scarce resources and we may need more labour or expensive capital to extract that additional unit of steel from the mines to create a microchip for example.to solve this problem you decide to import cheaper raw materials from China and decrease production as raw materials are needed to produce other commodities plus you don't want to worsen the economic problem.

Final regards

In Conclusion Economists can utilise mathematics to build accurate models from which exact conclusions are drawn using mathematical logic, which can then be evaluated using statistical data and used to create measurable estimates about future economic activity. We have explored how maths has allowed us to breakdown an economical problem in smaller Peaces to solve the various Economic problems of your country "Mathematics". Thanks for reading my research this have a good day.

Resources and helpers

My economics teacher Miss Lewis for (verifying my economic theory)

My two-maths teachers Mr Odjulaja and miss Kortoon(for verifying my mathematical theory)

Professor Jason Kronewetterat at the university of University of California, Irvine (for teaching me about Geometric series and how is used in economics)

https://www.youtube.com/watch?v=a20OW3hl1ow&t=1709s