The Truth About Math: series calculus

The purpose of this work is to show some evidence that the complex mathematical practice that we call "the calculus," which was developed by Newton and Liebniz at the same time, obtains the same results as the simpler process of composing an arithmetic series, which process is also known as "mathematical induction."

Everything in reality is a series. That is, every natural process begins with a current condition (or current term, k) and then proceeds, by the unfolding or evolution of the universe and the local process, to the next condition (next term, k+1). Using our mathematical language technology, we begin each series with a zero, and sometimes with a one for the initial condition. In the real, physical universe, we cannot retrieve enough information to know with meaningful certainty what was the initial condition of the universe. However, in order to see the current evolution we need only to identify a functioning definition or description of the current condition (term) or immediately previous condition (next term). In the real, physical universe that we observe through the discipline called "chemistry," the evolution of the natural universe proceeds strictly through the action of proportion or the geometrical shapes of matter. Our perceptions of those geometrical shapes form a descriptive or "explanatory" language in our brains, and that language is what mathematics is, a cultural artifact of the human species. If there were no humans, there would be no mathematics, just evolution without a perceiver to observe it, measure it, discuss it and struggle to understand it.

The Dramatic Quadratic

Do you remember the big quadratic equation?

$$ax^2 + bx + c = 0$$

This represented a variety of equations rearranged so that they were *quadratic in form*. It was okay for equations to be quadratic in form, but not kids. Ah! Those were the days! Peggy Sue was growing soft curves and scenes of radical romance rose in my mind exponentially in imaginary numbers. I remember it well.

You could solve a quadratic equation three ways (and you still can--some things never change). (1) by factoring; (2) by completing the square; (3) by using the formula. The formula was the result of completing the square using the variables. The resulting formula, which is stored in your brain somewhere (maybe behind the chili) is:

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

This way, there really were two possible answers, or solutions, to the quadratic equation. One had the minus sign in front of the radical sign (the discriminant) and the other had the plus sign in front of the radical sign.

One: $$\frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

Two: $$\frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

This also meant that one of the solutions could be a minus amount, and for most problems, a minus amount made no sense. So, that solution got chucked. This is very interesting, and we will see how interesting in a few moments. If you feel the need to follow this in detail as it is explained in a good math textbook, take one of your math textbooks off your bookshelf and look at it. What? You don't have a math textbook in your house? What kind of a person are you, anyway? A house without a math textbook is like a cat without whiskers. Get one. Better, get five. I have about sixty, and I want another hundred at least, maybe five hundred; maybe a copy of every math textbook ever published. Why not? How many junk videos do you have in your home? How many cans of old paint?

So here's a quadratic equation problem, from Lial and Miller *Intermediate Algebra/3*. After we do the dusty old problem, we will ham it up a bit to make it more interesting, add a couple of characters.

Johnny the lawn boy (that's me) works for the customers who hire a kid to work for less and they save money. Mr. and Mrs. Bigbucks own a swimming pool that they bought at Sears. The pool is 20 feet by 30 feet, just big enough for Ms Bigbucks to splash around with her floating bar and toy poodle. When the pool was installed, the soil around it was bare and they would like it seeded so that it is nice soft grass. They want me to seed it, but they don't want the cost of the seed and labor to cost any more than ten dollars. They want the best grass seed, which costs about a penny to seed a square foot (that would actually be very expensive grass seed). I have selected the grass seed, which costs \$10.00 for three pounds, and is labeled as enough to seed 1,000 square feet. The Bigbucks would like a strip around the pool of at least three feet in width, or greater if the price is the same. Since I am very astute at figuring out these things mathematically, and I need to in order not to work for nothing, I see that this problem can be solved by setting up an equation that is *quadratic in form*. My day is saved.

Here is the way it is done, as very clearly described in Lial and Miller. The width of the strip (unknown thus far) is designated as "x". If a drawing will help you, as I am sure it would, get a paper and pencil or pen, and make one. It is better if you make the drawing. That way you participate instead of just nodding your head. Draw a rectangle, and then draw a larger rectangle around it. The inner rectangle is the pool. (You can draw Mr. and Ms. Bigbucks in the pool if you are inclined.) The outer rectangle is the outer boundary of the grass strip. Since the pool is 20 by 30 feet, the width of the outer rectangle is 20 + 2x and the length is 30 + 2x (the inner dimensions plus 2 grass strips). Now we see that the area of the outer rectangle is (20 + 2x) x (30 + 2x) and the area of the inner rectangle (the pool) is 20 x 30 or 600. The problem as shown in the book tells us that we want the area to be seeded to be 336 square feet because we have enough seed for 336 square feet. This is one of those problems that got created before it was solved, so you will soon see why we want the area to be 336 square feet. We need to compute the area of the outer rectangle and subtract the area of the inner rectangle, and we have already decided in advance that the result will be 336 square feet.

$(20 + 2x) \times (30 + 2x) - (20 \times 30) = 336$ [start multiplying]
$(20 + 2x) \times (30 + 2x) - 600 = 336$ [multiply again]
$(600 + 40x + 60x + 4x^2) - 600 = 336$ [combine common factors]
$100x + 4x^2 = 336$ [rearrange the equation to be quadratic in form]
$4x^2 + 100x - 336 = 0$ [a = 4, b = 100, c = -336] [divide by 4]
$x^2 + 25x - 84 = 0$ [can be factored, or use formula if you want]
$(x + 28) \times (x - 3) = 0$ [$(x + 28) \times (x - 3) = x^2 + 25x - 84$]
$x + 28 = 0,\ x = -28$ and $x - 3 = 0,\ x = 3$

The solution of - 28 is nonsense, because we cannot have a real width of anything having a dimension of -28; therefore, the other solution, 3 feet, is the winner. You can readily see that if x is 3 feet, it is true that $100x + 4x^2 = 336$. So the solution to our problem conveniently allows us to use exactly the amount of seed we have on hand to produce a strip 3 feet in width around the pool. Nice. But boring.

Let's make the problem a little more complicated and more realistic. The

Bigbucks also have a flower garden that is 28 feet by 42 feet. That two has bare dirt around it and they would like it seeded, but they are not sure how wide they want the strip to be. Also, I don't have any grass seed on hand. I have to buy the seed, and I already know, after only a half hour of computations and drawings, that I will need enough to seed 336 square feet (that's $3.36 for the penny a square foot seed). After a three-hour discussion, the Bigbucks sadly have agreed to pay up to $10.00 for the grass seed, and up to $10.00 for the labor to seed a strip around the pool and a strip around the garden. They would like the strip around the garden to be at least 3 feet wide, just like the strip around the pool, or greater so long as the cost is contained within the $20 limit. So now we have a dramatic question. You can feel the tension. If I can buy $10.00 worth of grass seed, I can seed up to 1,000 square feet. But, since I know I will use up 336 square feet for the pool, I will have enough seed left for up to 664 square feet for the strip around the garden. I need to know how wide I can make that strip around the garden. So now, I write my new equation for the garden project, with the width of the strip around the garden designated as "y":

$(28 + 2y) \times (42 + 2y) - (28 \times 42) = 664$ [start multiplying]
$(28 + 2y) \times (42 + 2y) - 1176 = 664$ [multiply again]
$(1176 + 56y + 84y + 4y^2) - 600 = 336$ [combine common factors]
$140y + 4y^2 = 664$ [rearrange the equation to be quadratic in form]
$4y^2 + 140y -664 = 0$ [a = 4, b = 140, c = - 664] [or divide by 4]
If you divide by 4, then you get:
$y^2 + 35y -166 = 0$ [a = 1, b = 35, c = - 166]

If you plug either set of values into the quadratic formula, you get the same results, a useless minus value, and the value of 4.23... feet for the width.

One: $$\frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

-140 - sqrt[19,600 - (4 * 4 * -664)] = -140 - sqrt[19,600 + 10,624], all / 8
= - 39.23131381

-35 - sqrt[1,225 - (4 * 1 * -166) = -35 - sqrt[1,225 + 664], all / 2
= - 39.23131381

Two: $\dfrac{-b + \sqrt{b^2 - 4ac}}{2a}$

-140 + sqrt[19,600 - (4 * 4 * -664)] = -140 + sqrt[19,600 + 10,624], all / 8
= 4.231313812

-35 + sqrt[1,225 - (4 * 1 * -166) = -35 + sqrt[1,225 + 664], all / 2
= 4.231313812

Since I do not want to try to measure 0.23 feet, I can round that solution off to 4 feet. After making some calculations, I could see that in order to have a result of 4 feet for the width around the garden, I needed to have the square root of the discriminant be 172 (so that 172 - 140 will be 32, and 32/8 = 4). Working backwards, I found that 172 squared is 29,584, so that I needed the 4ac part to be equal to - 9,984 (19,600 + 9,984 = 29,584). Since the 4a part equals 16, the c needs to be 9,984 divided by 16, and that amount is 624. This means that if I make the width of the strip around the garden 4 feet, the total area of the strip will be 624 square feet. And, 336 square feet around the pool, plus 624 square feet around the garden, is 960 square feet. I made it under the $10.00 maximum for the seed!

Looking back, my new quadratic equation is:

a = 4, b = 140, c = 624, and therefore equation is: 4x^2 + 140 - 624 = 0

Two: $\dfrac{-b + \sqrt{b^2 - 4ac}}{2a}$

- 140 + sqrt[19,600 - (4 * 4 * - 624)] = - 140 + sqrt[19,600 + 9,984], all / 8
= 4 (as pre-calculated)

Let's see if that is right using a simpler method. Starting with a rectangle of garden that is 28 feet by 42 feet, consider what occurs when we have a strip one foot wide. If we say that we are extending the additional foot at each end of the 42 foot length, we now have an outer length of 44 feet. But, we do not add another 2 feet to the width. If we did, we would be overlapping the additional foot already extended at each end. You can help yourself by making a drawing of this. Therefore, the square feet area of the one-foot strip will be:

(1) (44 x 2) + (28 x 2) = 88 + 56 = 144 [and if we add another foot, now we need to extend the width also]

(2) (46 x 2) + (30 x 2) = 92 + 60 = 152 [area added with 1 foot of width added]

(3) (48 x 2) + (32 x 2) = 96 + 64 = 160 [area added with 1 foot of width added]

(4) (50 x 2) + (34 x 2) = 100 + 68 = 168 [area added with 1 foot of width added]

(5) (52 x 2) + (36 x 2) = 104 + 72 = 176 [area added with 1 foot of width added]

Do you see the series? Watch what happens when we add these areas:

(1)	0 + 144 =	144	
(2)	144 + 152 =	296	
(3)	296 + 160 =	456	
(4)	456 + 168 =	624	[our area with a 4 foot wide strip]
(5)	624 + 176 =	800	

You must have noticed that each new foot of strip adds 8 square feet more than the previous foot added. I'll bet you can write the series yourself now, but I will write it out anyway.

n (1--> X), W = width, A = added area of strip

$Wn = W_{(n-1)} + 8$, $W_0 = 136$; $An = A_{(n-1)} + Wn$, $A_0 = 0$

1	$W_1 = W_0 + 8$	$A_1 = A_0 + W_1$	
	$W_1 = 136 + 8 = 144$	$A_1 = 0 + 144 =$	144
2	$W_2 = W_1 + 8$	$A_2 = A_1 + W_2$	
	$W_2 = 144 + 8 = 152$	$A_2 = 144 + 152 =$	296
3	$W_3 = W_2 + 8$	$A_3 = A_2 + W_3$	
	$W_3 = 152 + 8 = 160$	$A_3 = 296 + 160 =$	456
4	$W_4 = W_3 + 8$	$A_4 = A_3 + W_4$	
	$W_4 = 160 + 8 = 168$	$A_4 = 456 + 168 =$	624
5	$W_5 = W_4 + 8$	$A_5 = A_4 + W_5$	
	$W_5 = 168 + 8 = 176$	$A_5 = 624 + 176 =$	800

Or, we could write the series as follows: $A_0 = 0$, $A_1 = A_0 + (17 + n)(8)$

n (1-->X)

1	$A_1 = A_0 + (17 + n)(8) =$	0 + (18 x 8) =	144	($1.44)
2	$A_2 = A_1 + (17 + n)(8) =$	144 + (19 x 8) =	296	(+ $1.52)
3	$A_3 = A_2 + (17 + n)(8) =$	296 + (20 x 8) =	456	(+ $1.60)
4	$A_4 = A_3 + (17 + n)(8) =$	456 + (21 x 8) =	624	(+ $1.68)
5	$A_5 = A_4 + (17 + n)(8) =$	624 + (22 x 8) =	800	(+ $1.76)

This way, I can calculate how much area is added each time I expand the width of the grass strip by 1 foot. Then, if the Bigbucks tell me they are willing to spend more money on grass seed, I can tell them how much they will have to spend for the additional grass seed for each added foot. All this work was done just to show that with the dramatic quadratic equation, we still can deconstruct our "problem" and express it as a series or sequence of solutions where each solution evolves from the previous solution and the only evolutionary "event" that has occurred is *addition*.

Invalid Solutions

What was previously referred to as "very interesting" will now be revealed. On Page 240 of Lial and Miller, which is an excellent math text, the following statement appears:

> "This example shows that it is important to check all proposed solutions against the information of the original problem. Numbers that are valid solutions of the equation may not satisfy the physical conditions of the problem."

This statement is actually a statement in support of the viewpoint that the universe is not mathematical. This statement is an admission that mathematics is technology that does not necessarily represent the real physical world. If our mathematics truly represented the real world, there could not be a numerical "solution" that was not a valid solution in the real world. Here, we see that established mathematicians among the "institutional conformists" have noticed a fact that should lead them to the rational conclusion that mathematics is human technology. Mathematics is counting and measuring, measuring and counting. No matter how complex it gets, it is all the means by which the brain measures and counts. The non-living non-conscious matter of the universe does not measure or count; it simply does all that it does through the natural evolutionary effects of proportion.