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# Fermat's Last Theorem

Pierre de Fermat is now known as one of the greatest number theorists to have ever studied the subject of mathematics. Originally a lawyer, Fermat was technically an amateur mathematician and only had one mathematical paper released to the public in his entire lifetime. Even more surprising was his only mathematical paper was submitted anonymously; It was written as an appendix to one of his colleagues' books. Fermat always refused to submit his work; Whenever he came up with brilliant ideas, his colleagues feared that his work would eventually be lost. This is why Pierre's son Samuel made it one of his goals to collect all of his father's letters, mathematical papers, and mathematical comments/ notes he made within his books to publish them. Without his son publishing his fathers work, Fermat's Last Theorem may never have been discovered

Fermat's last theorem stated x raised to the power of n plus y to the power of n equals z to the power of n with n being a natural number greater than 2. Samuel discovered this after his father's death written in the margin of his father's copy of Diophantus's *Arithmetica.* According to *Britannica.com* (2017), when transferred from Latin to English, Fermat wrote the following: "It is impossible for a cube to be a sum of two cubes, a fourth power to be a sum of two fourth powers, or in general for any number that is a power greater than the second to be the sum of two like powers. I have discovered a truly remarkable proof [of this theorem], but this margin is too small to contain it ". This note was just a small fraction of what turned into being a remarkable theorem that changed the thought process of many mathematicians.

Although centuries have gone by, mathematicians were still puzzled by Fermat's last theorem; No one could prove or disprove it. Over the years, many different proofs for a specific value of n were devised. Fermat himself did another proof of a theorem when n is equal to four. By 1993, with the help of technology, it was confirmed by mathematicians for all prime numbers n less than four million. During this time, mathematicians were on their way to proving Fermat's last theorem. Mathematicians figured out a connection between Shimura-Taniyama-Weil conjecture and Fermat's last theorem. Using algebraic geometry and number theory, it could be seen that proving the Shimura-Taniyama-Weil conjecture would be the same as proving Fermat's Last Theorem. There was an English mathematician named Andrew Wiles who has been fascinated by the theorem since the age of ten. In 1993, Andrew came up with a proof for the Shimura-Taniyama-Weil conjecture. Unfortunately, they found an error in his proof, but with the help of a former student Richard Taylor he was able to determine the correct proof. Wiles proof was published in the math journal "Annals of Mathematics" in 1995. It took wiles collectively eight years to prove the Shimura-Taniyama-Weil conjecture and Fermat's theorem, thus proving that Fermat was correct the whole time. Indeed, x raised to the n plus y raised to the n equals z raised to the end with n being greater than two has no whole number solutions.

The proof of Fermat's theorem is very complex and took a significant amount of time to figure out. Andrew Wiles' original explanation of the proof, before finding errors, took around 3 days in a lecture. It is astonishing to think that such a small equation took an extensive amount of time to explain why there was no solution. Andrew Wiles was a research professor at the University of Oxford that specialize in number theory. Therefore, any mathematician that would be able to understand Wiles' proof to Fermat's last theorem would have to have had previously dealt with number theory.

Another famous conjecture was Goldbach's conjecture. This conjecture was one of the oldest and well known unsolved problems in all of mathematics. It was written on June 7, 1742 in a letter to someone named Euler. In the letter, it stated, "At least it seems that every number that is greater than 2 is the sum of three primes". It should be taken into account that at the time Goldbach considered one to be a prime number which we now know is not true. That phrase helps to conclude that every even integer is the sum of two prime numbers; This makes sense because many of the prime numbers are odd numbers.

However, Euler re-expressed this into an equivalent form of the conjecture which states that all positive even integers greater than or equal to four can be expressed as the sum of two primes. In 1977, a man named Pogorzelski claimed to have a proof of the conjecture but his proof is not accepted by many people. Although this has never been proven, a mathematician by the name of Harald Helfgott was able to prove a variation of Goldbach's conjecture; Every odd number that is greater than five can be expressed by the sum of three prime numbers.

Another famous conjecture that I found was the twin prime conjecture which is also known as Polignac's conjecture. This conjecture states that there are infinitely many twin primes that differ by two. As an example, three and five, five, and seven. Not much progress was made to prove this conjecture, But in 1919 a mathematician of Norwegian descent named Viggo Brun proved that the sum of the reciprocals of the twin primes meet to a sum. This is now known as Brun's constant. Although this conjecture has yet to be proven people today are making great efforts to prove these conjectures.

In conclusion, Fermat's last theorem created a ripple effect of exemplary thought processes within the mathematician community. To think all of these mathematical advancements stemmed from a small note written on the inside of a lawyers book helps to realize that not every advancement is monumental from the start; it is how other minds interpret it that create more ideas, thoughts, and findings to better understand the concept of mathematics and its significance. The derivation of this theorem and its impact on mathematics was so important, a Documentary movie based on Fermat's last theorem was created in 1996 for the BBC program *Horizons.* Therefore, it is essential to realize the importance of Fermat's contribution to mathematics with this theorem and the repercussions brought on by it being published.

# Sources


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