Fermat's Last Theorem is Verified With Two Algebraic Equations

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1 Abstract

This two-page proof, by contraposition, of Fermat's last theorem, uses two analogous forms of a previously overlooked equation, each of which is equivalent to rational $z^n - y^n = x^n$. A relationship in common reveals the $n = 1, 2$ limitation.

2 Introduction

For integral $n \geq 1$, well-known $z^n - y^n = x^n$ holds for simultaneously positive integral z, y, x. Fermat's last theorem (FLT), which has no established simple proof, states, for $n > 2$, that z, y, x cannot simultaneously be positive integral.

We plan to show, for two equations each equivalent to rational $z^n - y^n = x^n$, that an in-common relationship of their variables reveals the truth of FLT.

3 Two Simple, Analogous, Algebraic Equations

Let us represent $z^n - y^n = x^n$ by a formula that evaluates as $z^n - y^n = x^n$:

$$z^n - \left((x^n + y^n - (2^{m_1})(q_1)^n))^{\frac{1}{n}}\right)^n = (2^{\frac{m_1}{n}} q_1)^n. \tag{1}$$

For integral $n \geq 1$, equation (1) holds for rational $z > 0, y > 0, x > 0$ with $z > (x^n + y^n - 2^{m_1}(q_1)^n)^{\frac{1}{n}}$, and $(x^n + y^n) > 2^{m_1}(q_1)^n$, for any given rational $q_1 > 0$ and for any given $m_1 = kn$ for which k is any given positive integer.

$$z^n - \left((x^n + y^n - (2^{m_2})(q_2)^n))^{\frac{1}{n}}\right)^n = (2^{\frac{m_2}{n}} q_2)^n. \tag{2}$$

For integral $n \geq 1$, eq (2) holds for any given rational $q_2 > 0$, and for any given even $m_2 \geq 2$. The same z, y, x, n are used with (1), (2) as in $z^n - y^n = x^n$.

Note. To relate $2^{\frac{m_2}{n}} q_2$ of (2) with x of satisfied $z^n - y^n = x^n$, restrict m_2 to even values : By inspection, $2^{\frac{m_2}{n}} q_2$ is non-rational with odd m_2 for even n; so, for $n = 2$, no rational $\{2^{\frac{m_2}{n}} q_2\}$ exists to relate with factually rational $\{x\}$.

4 Rational Fermat Triples/ Applicable Values

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Def 1A. The *rational Fermat triple* of $z^n - y^n = x^n$ is the set $\{z, y, x\}$, for which each part of the triple is simultaneously rational; **Def 1B**. Call *applicable* the values of each rational part of the rational Fermat triple.

Def 2A. The *rational Fermat triple* of (1) is $\{z, (x^n+y^n-2^{m_1}(q_1)^n)^{\frac{1}{n}}, 2^{\frac{m_1}{n}}q_1\}$ for which each part of the triple is simultaneously rational. **Def 2B**. Call *applicable* the values of each rational part of the rational Fermat triple.

Def 3A. The *rational Fermat triple* of (2) is $\{z, (x^n+y^n-2^{m_2}(q_2)^n)^{\frac{1}{n}}, 2^{\frac{m_2}{n}}q_2\}$ for which each part of the triple is simultaneously rational. **Def 3B**. Call *applicable* the values of each such part of the rational Fermat triple.

5 Proving Equivalence of (1), (2), $z^n - y^n = x^n$

For any given n, the set of $\{2^{\frac{m_1}{n}}q_1\}$ takes any given possible applicable value of x : With n cancelling out, $\{2^k q_1\}$, thus, $\{2^{\frac{m_1}{n}}q_1\}$, is a set of all rational values.

Calculate, by solving the following eq, that $(x^n + y^n - 2^{m_1}(q_1)^n)^{\frac{1}{n}} = y$ if and only if $2^{\frac{m_1}{n}}q_1 = x$. For any given value of n, it follows that the set of $\{(x^n + y^n - 2^{m_1}(q_1)^n)^{\frac{1}{n}}\}$ comprises any given value of *possible* applicable y.

So, the set of all positive rational Fermat triples for $z^n - y^n = x^n$ is equal to the set of all such Fermat triples for $z^n - \left((x^n + y^n - 2^{m_1}(q_1)^n)^{\frac{1}{n}}\right)^n = (2^{\frac{m_1}{n}}q_1)^n$.

Using the above reasoning with (2) : As an example, for $n = 37$, take m as 74, 148 ... . Therefore, $2^{\frac{m_2}{n}}q_2 = x$, and $(x^n + y^n - 2^{m_2}(q_2)^n)^{\frac{1}{n}} = y$. Hence, for any given n, equations (1), (2) have equal sets of all rational Fermat triples.

6 Relating the set of $\{m_1, q_1\}$ to the set of $\{m_2, q_2\}$

Inspection of (1), (2) shows the following : For any given n, any given (m_1, q_1) yields any given possible applicable value of $2^{\frac{m_1}{n}}q_1$; however, *solely for* $n = 1, 2$, any given (m_2, q_2) yields any given possible applicable value of $2^{\frac{m_2}{n}}q_2$.

Per the above **Note**, of the two terms $2^{\frac{m_1}{n}}q_1$ and $2^{\frac{m_2}{n}}q_2$, term $2^{\frac{m_2}{n}}q_2$ alone, due to m_2, is directly and specifically connected to rational Fermat triples.

Consequently, equation (2) yields any given *actual* applicable value of $2^{\frac{m_2}{n}}q_2$.

The in-common relationship of $\{m_1, q_1\}$ with $\{m_2, q_2\}$, which yields identical possible such applicable values, occurs for $n = 1, 2$. Thus, (2) comprises *actual* positive rational Fermat triples for sole values $n = 1, 2$ of the set of all $\{n\}$.

7 Results

If $z^n - y^n = x^n$ has a positive rational Fermat triple, then, (2) has a such rational triple. For $n > 2$, equation (2) has no positive rational Fermat triple.

8 Conclusion

For $n > 2$, no positive rational Fermat triple satisfies $z^n - y^n = x^n$. Ergo, for $n > 2$, the subset of all positive integral such Fermat triples is null. QED