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Pi Calculation Reinvented a Trigonometry

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ABSTRACT

In this study, we present a novel method for determining the mathematical value of pi by utilizing the relationship between pi and the tangent function in trigonometry. By examining the relationship between the circumference of a circle and a right-angled triangle, we can derive a new equation for pi, that can be used to simplify the mathematical and physical equations that involve pi.

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Introduction

Pi, denoted by the Greek letter π, is a mathematical constant widely used in mathematics and physics. It is defined as the ratio of the circumference of a circle to its diameter and, has a value of approximately 3.14159. The concept of pi has been known since ancient times, and has been studied by many mathematicians. Despite its importance, pi is an irrational number, meaning that it cannot be expressed as the ratio of the two integers. The note angle was measured in degrees.

Methods

According to the equation for the circumference of a circle, 2πr, if the circumference is visualized as a straight line, the length of the straight line would be 2πr. If we now imagine that the radius of circle r is perpendicular to this straight line, we would have the shape of a right-angled triangle.

A question arises, is there a relationship between this triangle and the circle?

We assume that the area of this triangle is equal to the area of circle πr^2 and the area of our triangle is $\frac{2\pi r \times r}{2} = \pi r^2$

According to the cotangent law, $tan\,\theta = \frac{r}{2\pi} = \frac{1}{2\pi}$ So, the $\theta \cong 9.043°$ ... We will write the equation as follows

$tan(9.04306) = \frac{1}{2\pi}$. The value of Pi can be determined as follows:

$$\pi = \frac{1}{2 \times tan\,9.043°}$$

We use the above deductions to apply them to laws utilizing pi.

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$$

Example1 Euler's Approach

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$$

If we use the new value for pi the Euler's approach will be

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\left[\frac{1}{2\,tan\,9.043°}\right]^2}{6}$$

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{1}{24(tan\,9.043°)^2}$$

And because $tan\,\theta = \frac{sin\,\theta}{cos\,\theta}$ the impediment will have another aspect, which is

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{(cos\,9.043°)^2}{24(sin\,9.043°)^2}$$

It is apparent that if the radius of the circle is fixed and the circumference of the circle represented by a straight line in the triangle is divided into half, quarter, or smaller segments, the equation takes the following form:

$$tan\,\theta = \frac{n}{2\pi} \quad \text{or} \quad \pi = \frac{n}{2 \times tan\,\theta} \quad n \neq 0$$

We will get Multiple angle values were obtained by varying n. We can now incorporate π into laws and equations containing trigonometric functions and similarly include trigonometric functions in laws and equations that involve π.

Example2 n=2

$$tan\,\theta = \frac{2}{2\pi} = \frac{1}{\pi}$$

$$tan\,\theta = 0.3183\,°$$

$$\theta = 17.65° \text{ at } n = 2$$

$$\pi = \frac{1}{tan\,17.65°}$$

Example 3 in Physics Field

where the constant $\mu_\circ$ is known as the permeability of free space and has the value of

$$\mu_\circ = 4\pi \times 10^{-7}$$

If we substitute the value of π, the general law is as follows:

$$\mu_\circ = 4\frac{n}{2 \times tan\,\theta} \times 10^{-7}$$

Or the law will be as follow if *n*=2:

$$\mu_\circ = \frac{4}{tan\,17.65°} \times 10^{-7}$$

Example4 if *n*=*e*:

$$tan\,\theta = \frac{e}{2\pi}$$

$$\pi = \frac{e}{2 \times tan\,23.39°}$$

Example5 if *n*=*h* Plank constant:

$$tan\,\theta = \frac{h}{2\pi}$$

$$\pi = \frac{h}{2 \times tan(6.04 \times 10^{-33})°}$$

We established a relationship between pi and the tan angle. However, we aimed to simplify the law connecting them. To achieve this, we first impose the relationship in the following manner.

$$\pi = n \times \tan\,\theta$$

Example 6 if n=e:

$$\pi = e \times tan\,\theta$$

$$tan\,\theta = \frac{\pi}{e}$$

$$\theta = 49.13°$$

$$\pi = e \times tan\,49.13°$$

Compare example4 the angle is 23.39 example6, angle is 49.13 when *n*=*e*

Example 7 if $n = e^{\pi i}$:

$$\pi = e^{\pi i} \times tan\,\theta$$

$$tan\,\theta = \frac{\pi}{e^{\pi i}}$$

We know from Euler's identity equation

$$e^{\pi i} + 1 = 0$$

$$\theta = -72.34°$$

$$\pi = e^{\pi i} \times tan(-72.34°)$$

We can convert any non-zero real number, whether positive or negative, into a number related to pi and the tangent.

Example 8: number 5 can convert to:

$$5 = \frac{\pi}{tan\,32.14°}$$

Results: Our method enabled us to determine the value of pi. The new equation

$$\boldsymbol{\pi = n \times tan\,\theta} \qquad \boldsymbol{n \neq 0}$$

Derived in this study can also be used to simplify the mathematical and physical equations that involve pi by replacing pi with the equivalent value derived in this study and converting any number into a number related to pi and tangent.

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Ethical Compliance Statement

All procedures involving human participants in this study were conducted in accordance with the ethical standards of the institutional and/or national research committee, as well as the 1964 Helsinki Declaration and its later amendments, or comparable ethical standards.

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