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The area of a hyper-triangular figure formed by the tangent line of the unit circle in the *x*-*y* coordinate system and the coordinate axes, and division by zero and *x*-intercept speed

1. The area of a hyper-triangular figure formed by the tangent line of the unit circle in the *x*-*y* coordinate system and the coordinate axes and division by zero

Consider the unit circle $y^2 + x^2 = 1$ in *x*-*y* coordinates. In particular, it is sufficient to consider only the first quadrant. Therefore, the formula for the unit circle is

$$y = \sqrt{1 - x^2} \qquad (1)$$

Let the coordinates of a point P on the unit circle be expressed as (p,q). The equation of the line that is tangent to the unit circle is given by

$$px + qy = 1 \qquad (2)$$

Let the ranges for the coordinates of point P (p,q) be:

$$0 \le p \le 1$$
$$0 \le q \le 1$$

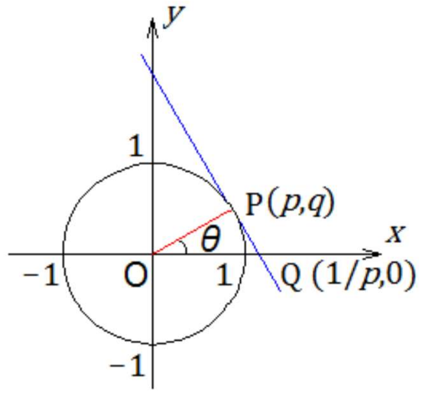

Fig. 1 A hyper-triangle in the range of a right triangle

Here, consider the region that is enclosed by the tangent line represented in Equation (2), the *x*-axis, and the *y*-axis. The base is the value of *x* when $y = 0$ in Equation (2). Therefore,

$$x = \frac{1}{p} \quad (0 \le p \le 1) \qquad (3)$$

The height is the value of *y* when $x = 0$ in Equation (2). Therefore,

$$y = \frac{1}{q} \quad (0 \le q \le 1) \qquad (4)$$

If the range of the point of contact is limited to $0 < p < 1$ and $0 < q < 1$, then the region that is enclosed by the tangent line, the x-axis, and the y-axis is a right triangle. Therefore, even in the range $0 \leqq p \leqq 1$ and $0 \leqq q \leqq 1$, if this right triangle holds (referred to as a hyper-triangle here), then the area s of the hyper-triangle is

$$s = \frac{1}{2pq} \qquad (5)$$

.

Considering the area s of this hyper-triangle in the range of this right triangle, then

$$\lim_{p \to 0} \mathrm{P}(p, q) = \mathrm{P}(\to 0, \to 1) \qquad (6)$$

.

This implies that

$$x = \lim_{p \to 0} \frac{1}{p} = \infty \qquad (7)$$

$$y = \lim_{q \to 1} \frac{1}{q} = \to 1 \qquad (8)$$

.

The notation → 1 on the right-hand side of Equation (8) represents a quantity that approaches infinitesimally close to 1, and is a strict version of the representation of limits. In other words, the middle of Equation (8) is a representation that means that q approaches infinitesimally close to 1. As a result, the right-hand side of Equation (8) implies that the value of the fractional function in the middle of Equation (8) approaches infinitesimally close to 1. In other words, the equivalence of the middle and right-hand side of the conventional representation,

$$y = \lim_{q \to 1} \frac{1}{q} = 1 \qquad (9)$$

,

does not hold. The middle of equation (9) is a number that represents a dynamic state (referred to as a dynamic number below), and the right-hand side is a number that has been determined, or in other words, a static number, and they are not strictly equal to each other. Therefore, by using the representation in Equation (8) as opposed to the representation in Equation (9), which lacks strictness, we attempt to make the representation stricter. In this way, it can be said that Equation (7) is a strict representation. Furthermore, if infinity ∞ is defined as a number for which $M < \infty$holds for a positive number M that is larger than any positive constant m, then in Equation (7), the right-hand side is represented as "∞" in contrast to the middle of the equation, which is a dynamic number, and because "∞" is a dynamic number, we can conclude that the relationship "dynamic number = dynamic number" holds. In this way, Equation (6) also makes a distinction between P(0,1) by using the notation P($\rightarrow 0, \rightarrow 1$). Although it is superfluous, the following equation,

$$\frac{1}{\infty} = 0$$

which uses the conventional notation style, can be rewritten as

$$\frac{1}{\infty} = \rightarrow 0$$

using this notation.

Let us return to the main topic. Considering the area *s* of this hyper-triangle within the range of the right triangle, we obtain

$$s = \lim_{\substack{p\to 0 \\ q\to 1}} \frac{1}{2pq} = \infty \qquad (10)$$

This implies that the area becomes large without bound. Next, we calculate the area *s* of the hyper-triangles with the two points of contact P(1,0) and P(0,1). We obtain

$$(1,0) \Rightarrow s = \frac{1}{2pq} = \frac{1}{2\cdot 1\cdot 0} = \frac{1}{0} = 0 \qquad (11)$$

and

$$(0,1) \Rightarrow s = \frac{1}{2pq} = \frac{1}{2\cdot 0\cdot 1} = \frac{1}{0} = 0 \qquad (12)$$

respectively. The hyper-triangles with points of contact P(1,0) and P(0,1) both degenerate to the points P(0,1) and P(1,0), and the area *s* becomes zero. This shows that the hyper-triangles are no longer triangles. Based on Equation (2), the equations for the tangent lines become

$$(1,0) \Rightarrow x = 1 \qquad (13)$$
$$(0,1) \Rightarrow y = 1 \qquad (14)$$

Refer to Fig. 2 and Fig. 3.

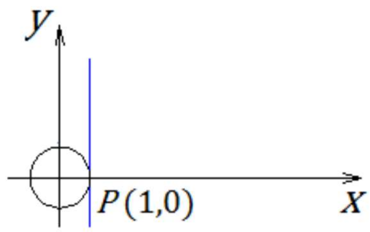

Fig. 2 A hyper-triangle that has degenerated to the point of contact P(1,0)

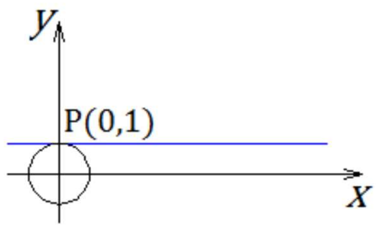

Fig. 3 A hyper-triangle that has degenerated to the point of contact P(0,1)

2. Regarding the moving speed v of the x-intercept

Let the point of contact P(p,q) move along the unit circle $y^2 + x^2 = 1$ from P(1,0) towards P(0,1) with an angular speed of $\omega = \pi/2$ centered at the origin O. Let Q(1/p,0) be the point of intersection between the tangent line and the x-axis, or in other words, the x-intercept. Then, the speed v at which the point of intersection Q moves away from the origin O in the positive direction (hereafter referred to as the x-intercept speed) is

$$x = \frac{1}{p} = \frac{1}{\cos \omega t} \qquad (15)$$

where t represents the time [s]. Taking the derivative of both sides of this equation for time t gives:

$$v = \frac{\mathrm{d}x}{\mathrm{d}t} = \frac{\mathrm{d}}{\mathrm{d}t}\frac{1}{\cos \omega t} = \omega \frac{\sin(\omega t)}{\cos^2(\omega t)} = \frac{\pi}{2}\frac{\sin\left(\frac{\pi}{2}t\right)}{\cos^2\left(\frac{\pi}{2}t\right)} \qquad (16)$$

.

Refer to Fig. 4.

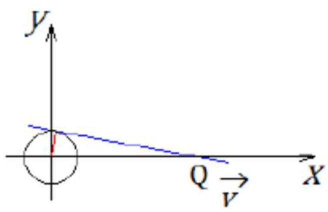

Fig. 4: Speed v of point of intersection

Of course, the point of contact P(p,q) reaches coordinates (0,1) after departing from coordinates (1,0) at

$$t = \frac{\theta}{\omega} \qquad (17)$$

because θ = ωt. θ = R (one right angle: the angle between the x-axis and the y-axis), and the angular speed ω = π/2. Therefore, we obtain

$$t = \frac{\theta}{\omega} = \frac{\pi/2}{\pi/2} = 1 \qquad (18)$$

In other words, in this case, the amount of time that is required for the point of intersection Q(1/p, 0) to depart from coordinates (1,0), move along the x-axis, increase its x-value infinitely while (1/p→0,0), and arrive beyond infinity (ultra-infinity), is 1 s. Furthermore, by setting t = 1 [s] in Equation (16), the x-intercept speed v becomes

$$v = \frac{\mathrm{d}x}{\mathrm{d}t} = \frac{\pi}{2}\frac{\sin\left(\frac{\pi}{2}t\right)}{\cos^2\left(\frac{\pi}{2}t\right)} = \frac{\pi}{2}\frac{\sin\left(\frac{\pi}{2}\cdot 1\right)}{\cos^2\left(\frac{\pi}{2}\cdot 1\right)} = \frac{\pi}{2}\frac{1}{0^2} = \frac{\pi/2}{0} = \frac{\omega}{0} = 0 \cdots \omega \qquad (19)$$

1 s later. (Here, ...ω refers to the remainder term according to reducible set theoretical division by zero). This implies that the speed of the point of intersection Q as it moves along the x-axis when it arrives at ultra-infinity from infinity, or in other words, the x-intercept speed v, is zero. Simultaneously, this also implies that the remainder speed μ = ω also remains. It is natural to conclude that the remainder speed μ implies that point P on the unit circle still has the remainder speed ω remaining at the instant when point Q traveling along the x-axis loses its speed on the x-axis. This also implies that this result corresponds to the fact that the angular speed ω of point P is conserved on the unit circle, and that the law of conservation of angular momentum also holds simultaneously. □