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THE ROOTS OF SOME ALGEBRAIC EQUATIONS ONE WAY TO DETERMINE

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ABSTRACT

In the article $e^x = \cos x + i\sin x$ *The Eyler formula was proved with the help of excellent limits, as well as with the help of which the method of determining the roots of some complex coefficients of algebraic equations was used.*

KEYWORDS: *Eyler's Formula, Algebraic Equations, Root, Komplex Numbers, Trigonometric Form, Striking Limits.*

INTRODUCTION

The Eyler formula $e^{ix} = \cos x + i\sin x$ (1) the real variable represents a link between the function and the theory of theesex variable function, and this plays an extremely important role. This article (1) Eyler's formula is devoted to the determination of solutions of an algebraic equation.

The theorem. The following attitude is appropriate $e^{ix} = \cos x + i\sin x$.

Proof: to prove the theorem, below we use certain limits and formula.

$\lim_{n\to\infty}(1+\frac{\alpha}{n})^n = e^{\alpha}$ (2)

$\lim_{x\to 0}\frac{\sin x}{x} = \lim_{x\to 0}\frac{arc\sin x}{x} = \lim_{x\to 0}\frac{\sin x}{arc\sin x} = \lim_{x\to 0}\frac{\sin x}{x} = \lim_{x\to 0}\frac{arc\sin x}{x} = 1$ (3)

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$(x+iy)=z(\cos\varphi+i\sin\varphi)$ (4);

$$z=\sqrt{x^2+y^2}$$

$$\varphi=\begin{cases} arctg\dfrac{y}{x}\text{agar } x>0 \\ \pi+arctg\dfrac{y}{x}\text{agar } x<0 \end{cases}$$

(2) if we look at α=xi:

$\lim_{n\to\infty}(1+\frac{xi}{n})^n=e^{xi}$ $(x+iy)=z(\cos\varphi+i\sin\varphi)$ (5)

$$z=\sqrt{x^2+y^2};$$

$$\left(1+\frac{xi}{n}\right)=z(\cos\varphi+i\sin\varphi, \qquad z=\sqrt{1+\frac{x^2}{n^{2,}}};$$

$$\varphi=arctg\frac{x}{n}$$

$(1+\frac{xi}{n})^n=z^n\cdot(\cos n\varphi+i\sin n\varphi)$; (6)

Putting (6) to (5,

$\lim_{n\to\infty}(1+\frac{xi}{n})^n=\lim_{n\to\infty}(1+\frac{x^2}{n^2})^{\frac{n}{2}}\cdot(\cos n\varphi+i\sin n\varphi)$; (7)

$\lim_{n\to\infty}(1+\frac{x^2}{n^2})^{\frac{n^2}{x^2}\cdot(\frac{x^2}{n})}=\lim_{n\to\infty}e^{\frac{x^2}{n}}=1$; (8)

$\lim_{n\to\infty}n\varphi=\lim_{n\to\infty}n\cdot=x\cdot\lim_{n\to\infty}\frac{arctg\frac{x}{n}}{\frac{x}{n}}=x$; (9)

The above attitude can be cited. Taking into account (7) and (8) formulas, (6) can be expressed as follows.

$$\lim_{n\to\infty}(1+\frac{xi}{n})^n=\cos x+i\sin x$$

Now let's look at the practical issues concerning the application of the above theorem and formula.

1. $f(x)=x^m-c_{2m}^2x^{m-1}+c_{2m}^4x^{m-2}+\cdots+(-1)^mc_{2m}^{2m}$;

Determine the roots of the polynomial and divide R into multipliers in the area of real numbers'(x) to determine the real coefficients of a polynomial and its roots, let's add the following function and denote f(x) in their means:

$$F(x+i)=\left(\sqrt{x}+i\right)^{2m}; F\left(\overline{x+i}\right)=(\sqrt{x}-i)^{2m};$$

$$f(x)=\frac{1}{2}\left(F(x+i)+F\left(\overline{x+i}\right)\right)$$

$$F(x+i) = (\sqrt{x}+i)^{2m} = z^{2m}(\cos n\varphi + i\sin n\varphi)^{2m} = z^{2m}(\cos 2m\varphi + i\sin 2m\varphi i)$$

$$F\left(\overline{x+i}\right) = z^{2m}(\cos 2m\varphi - i\sin 2m\varphi)$$

Given the above, it is possible to write f(x) in the following form:

$$f(x) = \frac{F(x+i) + F(\overline{x-i})}{2} = z^{2m}\cdot\frac{e^{2m\varphi i} + e^{-2m\varphi i}}{2} = z^{2m}\cos 2m\varphi;$$

In here$z = \sqrt{x+1}, x > 0, \varphi = arctg\frac{1}{\sqrt{x}} = arcctg\sqrt{x};$

$$f(x) = 0 \Longrightarrow z^{2m}\cos 2m\varphi = 0; z \neq 0 \Rightarrow \cos 2m\varphi = 0\ ; \cos 2m\varphi = \cos(\frac{\pi}{2} + \pi\kappa)\ ;$$

$$2m\varphi = \frac{\pi}{2} + \pi\kappa \Rightarrow \varphi = \frac{\pi}{4m}(1+2\kappa); arcctg\sqrt{x} = \frac{\pi}{4m}(1+2\kappa);$$

$$ctg\left(arcctg\sqrt{x}\right) = ctg\frac{\pi}{4m}(1+2\kappa);$$

$$\sqrt{x} = ctg\frac{\pi}{4m}(1+2\kappa) \Rightarrow x = ctg^2\frac{\pi}{4m}(1+2\kappa);$$

Given here cosx=0, the period of the roots of the equation is πκ: F(x)=0 write down the different roots of the equation

$$x_k = ctg^2\frac{2\pi}{4m}(1+2\kappa), \qquad \kappa = \overline{0, m-1}$$

According to the main theorem of algebra, it is possible to bring the multiplication of f(x) relative to the roots.

$$f(x) = 2\prod_{k=0}^{m-1}\left(x - ctg^2\frac{\pi}{4m}(1+2k)\right)$$

2. $f(x) = (x + \cos\theta + i\sin\theta)^n + (x + \cos\theta - i\sin\theta)^n$:

$$\phi_1(x) = F_1(x + \cos\theta + im\theta) = (x + \cos\theta + i\sin\theta)^n:$$

$$\phi_2(x) = \phi_1(\overline{x}) = F_1(\overline{x + \cos\theta + i\sin\theta}) = (x + \cos\theta - \mathrm{i}\sin\theta)^n:$$

$$f(x) = \phi_1(x) + \phi_2(x)$$

$$x + \cos\theta + \mathrm{i}\sin\theta = \sqrt{x^2 + 2x\cos\theta + 1}\,(\cos\varphi + i\sin\varphi) = \sqrt{x^2 + 2x\csc\cos\theta + 1}\cdot e^{ix}$$

$$\overline{x + \cos\theta + i\sin\varphi} = \sqrt{x^2 + 2x\cos\theta + 1}\,(\cos\varphi - i\sin\varphi) = \sqrt{x^2 + 2x\cos\theta + 1}\cdot e^{i\varphi},$$

$$\varphi = arctg\frac{\sin\theta}{x + \cos\theta} = arctg\frac{x + \cos\theta}{\sin\theta}$$

$$\phi_1(x) = (\sqrt{x^2 + 2x\cos\theta + 1})^n\cdot(\cos n\varphi + i\sin n\varphi) = z\cdot e^{n\varphi i}$$

$$\phi_2(x) = (\sqrt{x^2 + 2x\cos\theta + 1})^n(\cos n\varphi - i\sin n\varphi) = z^n\cdot e^{n\varphi i}.$$

$$z = \sqrt{x^2 + 2x\cos\theta + 1}$$

On the basis of the above substitutions marks, it is possible to write f(x) in the following form.

$$f(x) = (\sqrt{x^2 + 2x\cos\theta + 1})^n \frac{(e^{n\varphi i} + e^{-n\varphi i})}{2} = 2(\sqrt{x^2 + 2x\cos\theta + 1})^n \cdot \cos n\varphi,$$

$$f(x) = 0$$

$$\sqrt{x^2 + 2x\cos\theta + 1} \cdot \cos n\varphi = a$$

$$x^2 + 2x\cos\theta + 1 \neq 0, \qquad \cos n\varphi = 0$$

$$\cos n\varphi = \cos\left(\frac{\pi}{2} + \pi\kappa\right)$$

$$narcctg\frac{x + cos\theta}{sin\theta} = \frac{\pi}{2}(1 + 2\pi\kappa)arcctg\frac{x + cos\theta}{sin\theta} = \frac{\pi}{2n}(1 + 2\kappa)$$

$$ctg\left(arcctg\frac{x + cos\theta}{sin\theta}\right) = ctg\frac{\pi}{2n}(1 + 2\kappa)\frac{x + cos\theta}{sin\theta} = ctg\frac{\pi}{2n}(1 + 2\kappa)$$

$$x = sin\theta ctg\left(\frac{\pi}{2n}(+2\kappa) - cos\theta\right)x_k = sin\theta\left(ctg\frac{\pi}{2n}(1 + 2\kappa) - cos\theta\right)\kappa = \overline{0, n-1}$$

$$f(x) = 2\prod_{\kappa=0}^{n-1}\left(x + cos\theta - sin\theta ctg\frac{\pi}{2n}(1 + 2\kappa)\right)$$

3. $f(x) = c_n^1 x^{n-1} - c_n^3 x^{n-3} + c_n^5 x^{n-5} + \ldots$ let's define the roots of the polynomial, and then divide them into multipliers, for this we will add the denominators to the polynomial.

$$F_1(x + i) = (x + i)^n; \qquad F_2(x + i) = \overline{F(x + i)} = (x - i)^n;$$

$$f(x) = \frac{(F_1(x + i) - \overline{F_2(x + i)}}{2i} = \frac{(x + i)^n - (x - i)^n}{2i};$$

$$(x + i)^n = (\sqrt{x^2 + 1})^n \cdot e^{n\varphi i}; (x - i)^n = (x^2 + 1)^{\frac{n}{2}} \cdot e^{-n\varphi};$$

$$\varphi = arctg\frac{1}{x} = arcctgx$$

$$f(x) = (\sqrt{x^2 + 1})^n \frac{(e^{n\varphi i} - e^{-n\varphi i})}{2} = (\sqrt{x^2 + 1})^n \sin n\varphi$$

$$f(x) = 0 \Rightarrow \sqrt{x^2 + 1} \neq 0 \Rightarrow \sin\varphi = 0$$

$$\sin n\varphi = \sin \pi\kappa, \qquad \varphi = \frac{\pi\kappa}{n} \Rightarrow arcctgx = \frac{\pi\kappa}{2} \Rightarrow ctg(arcctgx) = ctg\frac{\pi\kappa}{2}.$$

$$x = ctg\frac{\pi\kappa}{n}, \qquad \kappa = \overline{1, n-1}$$

$$f(x) = c_n^1 x^{n-1} - c_n^3 x^{n-3} + \ldots = c_n^1 \prod_{\kappa=1}^{n-1} \left(x - ctg\frac{\pi\kappa}{n}\right)$$

The Eyler formula can be applied to the solution of complex coefficient equations similar to the above[1; 2]. The method used above plays an important role in the development of the dynamics of independent performance of students.

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