SOME METHODS OF FINDING ROOT LIMITS

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ABSTRACT

In this article, one of the main sections of algebra and number theory is written about methods of finding polynomials, their common divisors and roots and intervals of roots. The article can be used by students of higher educational institutions and those interested in algebra.

Keywords: *Polynomial, root, common divisor, derivative, limit.*

INTRODUCTION

It is known that for arbitrary $a_i \epsilon K, i \epsilon \{0\} \cup N$

$$f(x) = a_0 + a_1x + a_2x^2 + \cdots + a_nx^n$$

the expression is called a polynomial with (complex) coefficients. x in this expression is an unknown variable, $a_i \in K$ are the coefficients of the polynomial, and a_ix^i are called the terms of the polynomial. If $a_n \neq 0$, a_n is called a leading coefficient and a_nx^n is called a leading term, and a_0 term of the polynomial is called a free term. The largest degree of the unknown involved in the polynomial is called the degree of the polynomial and is defined as $deg f(x)$, that is, if $a_n \neq 0$, then $deg f(x) = n$. [1]

METHODS

If $\varphi(x)/f(x)$ and $\varphi(x)/g(x)$ hold for the polynomial $\varphi(x)$, then $\varphi(x)$ is the polynomial $f(x)$ and $g(x)$ is called the common divisor of the polynomial. If the polynomial $\varphi(x)$ is a common divisor of the polynomials $f(x)$ and $g(x)$, then the polynomial $c\varphi(x)$ is also a common divisor of these polynomials. Moreover, the divisors of the polynomial $\varphi(x)$ are also the common divisors of the polynomials $f(x)$ and $g(x)$. Finding the roots of given polynomials is also important in finding the common divisors of polynomials. Finding the roots of given polynomials is not always easy, and it is necessary to first find the limits of the roots of the polynomial.

RESULTS

We have real odds

$$f(x) = a_0x^n + a_1x^{n-1} + a_n\,, \qquad a_0 > 0.$$

be given a lot. If $f(x), f'^{(x)}, f''^{(x)}, \dots, f^{(n)}(x)$ take positive values at the point $x = c$ then c is the upper limit of positive roots will be

Because, according to Taylor's formula

$$f(x) = f(c) + (x-c)f'^{(c)} + (x-c)^2\frac{f'(c)}{2!} + \cdots + (x-c)^n\frac{f^{(n)}(c)}{n!}.$$

It can be seen that for all values of x greater than c, the polynomial f(x) takes only positive values. Therefore, the number c is the upper limit of positive roots.

A given polynomial $f(x)$ takes only positive values. Therefore, the number c is the upper limit of positive roots. To find the corresponding number c for a given polynomial $f(x)$, we proceed as follows. Since $f^{(n)}(x) = n!\,a_0$ is a positive number, the function $f^{(n-1)}(x)$ is increasing. So, there exists a number c_1 such that $f^{(n-1)}(x) > 0$ for $x \geq c_1$.

Now using the fact that $f^{(n-2)}(x)$ is increasing in case $x \geq c_1$, $f^{(n-2)}(x) > 0$ dividing c_2, $(c_2 \geq c_1)$. After repeating this process a finite number of times, the final number c_n gives us the number c we need, that is, the upper limit of the positive roots.

Metter. Using Newton's method for the polynomial

$$h(x) = x^5 - 3x^4 + 6x^3 + 5x^2 - 7x - 2$$

we find the upper limit of its positive roots and the lower limit of its negative roots:

$$h(x) = x^5 - 3x^4 + 6x^3 + 5x^2 - 7x - 2$$
$$h'(x) = 5x^4 - 12x^3 + 18x^2 + 10x - 7$$
$$h''(x) = 20x^3 - 36x^2 + 36x + 10$$
$$h'''(x) = 60x^2 - 72x + 36$$
$$h^{IV}(x) = 120x - 72$$

$h^V(x) = 120.$

It is not difficult to see that all the given polynomials are positive at $x = 2$ Thus, the number 2 is the upper bound of the polynomial positive roots of $h(x)$. To find the lower limit of negative roots, we look at the polynomial $\varphi_2(x) = -h(-x)$ and calculate its derivatives:

$$\varphi_2(x) = x^5 + 3x^4 + 6x^3 - 5x^2 - 7x + 2$$
$$\varphi_2{}'(x) = 5x^4 + 12x^3 + 18x^2 - 10x - 7$$
$$\varphi_2{}''(x) = 20x^3 + 36x^2 + 36x - 10$$
$$\varphi_2{}'''(x) = 60x^2 + 72x + 36$$
$$\varphi_2{}^{IV}(x) = 120x + 72$$
$$\varphi_2{}^{V}(x) = 120$$

All the given polynomials are positive at $x = 2$. So, the lower limit of negative roots is $= -2$.

CONCLUSION

The above method of finding the limits of polynomial roots is considered to be a simpler and more efficient method than other methods, and remembering the algorithm of this method is much easier than remembering other methods. Roots of polynomials are found by determining the limits of the roots of polynomials. This helps to find common divisors of several polynomials.

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