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VATAR OF METHOD

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Abstract: This article explores the secant method, an iterative numerical technique used to approximate the roots of nonlinear algebraic equations. Unlike the Newton-Raphson method, which requires the computation of derivatives, the secant method relies on drawing a secant line through two initial approximations to generate successive estimates of the root. The paper discusses the theoretical foundation of the method, its advantages and limitations, and provides a step-by-step implementation using the Python programming language. A detailed example is presented to demonstrate how the secant method can be effectively applied to find the positive root of a specific algebraic equation. Due to its simplicity and ease of implementation, the secant method remains a practical and widely used tool in numerical analysis.

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Keywords: secant method, iterative method, algebraic equation, numerical methods, root finding.

Аннотация: В данной статье рассматривается метод хорд (секущих) — итерационный численный метод, применяемый для приближённого нахождения корней нелинейных алгебраических уравнений. В отличие от метода Ньютона, метод хорд не требует вычисления производной функции, а основан на построении секущей через две начальные точки и нахождении её пересечения с осью абсцисс. В статье изложены теоретические основы метода, его преимущества и ограничения, а также приведена реализация на языке программирования Python. На конкретном примере подробно показано применение метода хорд для нахождения положительного корня заданного уравнения. Простота реализации и высокая эффективность делают данный метод актуальным инструментом численного анализа.

Ключевые слова: метод хорд, итерационный метод, алгебраическое уравнение, численные методы, нахождение корня.

Annotatsiya. Ushbu maqolada algebraik tenglamalarning ildizlarini aniqlashda qo‘llaniladigan vatarlar metodi (secant method) tahlil qilinadi. Vatarlar metodi – bu iteratsion (takroriy) hisoblash usullaridan biri bo‘lib, u berilgan funksiya grafigiga urinma chizmay, balki ikki nuqtani bog‘lovchi vatar (kesma) asosida yangi nuqtalarni aniqlash prinsipiga asoslanadi. Maqolada metodning nazariy asoslari, uning afzallik va cheklovlari, hisoblash formulasi hamda Python dasturlash tilida amaliy qo‘llanilishi ko‘rib chiqilgan. Shuningdek, aniq bir algebraik tenglama uchun bu metod yordamida musbat ildizni topish bosqichma-bosqich yoritib beriladi. Vatarlar metodining boshqa sonli metodlarga nisbatan soddaligi va dasturlashga qulayligi uning amaliy qiymatini belgilaydi.

Kalit so‘zlar: vatarlar metodi, iteratsion usul, algebraik tenglama, sonli metodlar, ildizni topish.

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Newton's method for the calculation of both the simplification again a method we see. Newton's method of work in the main part $f(x_n)$ and $f'(x_n)$ s calculation for are spent. Whose that ones, for example, $f'(x_n)$ to is get rid of can I do that the question arises. This us *vatar the method*to out - comes, is that if you $f'(x_n)$ see taqribiy on the basis of exchange:

$$f'(x_n) \approx \frac{f(x_n)-f(x_{n-1})}{x_n - x_{n-1}},$$

it without a regular approach to find the rules are as follows, will be:

$$x_{n+1} = x_n - \frac{f(x_n)(x_n - x_{n-1})}{f(x_n)-f(x_{n-1})}. \quad (1)$$

This rule geometrical meaning from the following is: $y = f(x)$ a function graph on two $M_{n-1}[x_{n-1}, f(x_{n-1})]$ and $M_n[x_n, f(x_n)]$ from the point watar we spent. Watar equation while follows:

$$\frac{x - x_n}{x_n - x_{n-1}} = \frac{y - f(x_n)}{f(x_n)-f(x_{n-1})}.$$

You this watar of *OX* axis with the intersection point as beneficially, (1) the rules come out.

Watar of method two stepped methods can be x_{n+1} to find to x_{n-1} and x_n to know that we need. (1) rule of application for:

1) bfir x_n the world $f(x)$'s identification in the field of may lay and
2) $f(x_n)-f(x_{n-1}) \neq 0 \ (n = 1, 2, ...)$ terms to be done should.

Ago $f(x_k)-f(x_{k-1}) \neq 0$ $(k = \overline{1, n-1})$ that's the case , see , let, this earth on two cases be can:a) $x_n \neq x_{n-1}$ and b) $x_n = x_{n-1}$.

If it $x_n \neq x_{n-1}$ is,

$$x_n = x_{n-1} - \frac{f(x_{n-1})(x_{n-1} - x_{n-2})}{f(x_{n-1}) - f(x_{n-2})}. \quad (2)$$

tmost from $f(x_{n-1}) \neq 0$ spotted we see. This is the reason for also $f(x_n) \neq 0$ and regular

$$x_{n+1} = x_n - \frac{f(x_n)(x_n - x_{n-1})}{f(x_n) - f(x_{n-1})}.$$

Approach to see I can 't. Also, this here is cut off and the solution is to get not comedi.

If it $x_n = x_{n-1}$ is, x_0, x_1, ..., x_{n-1}, x_n the world can see you, $x_0, x_1, ..., x_{n-1}$ the world of mutual difference and $f(x_k) - f(x_{k-1}) \neq 0$ $(k = \overline{1, n-1})$ that is we are. (2) from equal we'll see, $f(x_{n-1}) = 0$ and x_{n-1} given the equation of the solution is come out. This case series approach x_n pm complete you can, this , with , along with two stack-by-stack down x_{n-1} and x_n the value given in the equation solution is. The root of a rational number is, such cases be can.

Now we have the above 1), 2) the conditions have been fulfilled that assuming make, watar the methods to approach stop , you will pass. Error $\varepsilon_n = \xi - x_n$ for (1) from

$$\varepsilon_{n+1} = \varepsilon_n + \frac{(\varepsilon_{n-1} - \varepsilon_n) f(\xi - \varepsilon_n)}{f(\xi - \varepsilon_n) - f(\xi - \varepsilon_{n-1})}$$

relationship we are out of. We are this land $f(\xi - \varepsilon_n)$ and $f(\xi - \varepsilon_{n-1})$ the world of bugs to level comparison of don't spread

$$f(\xi - \varepsilon_n) = -f'(\xi)\varepsilon_n + \frac{1}{2} f''(\xi)\varepsilon_n^2 + ...,$$

$$f(\xi - \varepsilon_{n-1}) = -f'(\xi)\varepsilon_{n-1} + \frac{1}{2} f''(\xi)\varepsilon_{n-1}^2 + ...$$

to put it, the appropriate steps complete, the following approx

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$$\varepsilon_{n+1} \approx -\frac{1}{2}\frac{f''(\xi)}{f'(\xi)}\varepsilon_{n-1}\varepsilon_n \qquad (3)$$

equality able you will be. You this equality is newton's method for the issued $\varepsilon_{n+1} \approx -\frac{1}{2}\frac{f''(\xi)}{f'(\xi)}\varepsilon_n^2$ equity with we have compared, watar, the methods of the error change is the law of Newton on the rules of the law that is close we see.

Newton's methods of approaching the theorem to similar following theorem also is reasonable.

Theorem. You $f(x)$ the function and the initial approach x_0 1-teorema terms and conditions of content and also in addition x_1 to

$$|x_1 - x_0| < \frac{1-\sqrt{1-2h}}{h}\eta = t^* \text{ and } |f(x_1)| \le P(|x_1 - x_0|) = P(t_1)$$

disparity is carried outit without:

1) (1) rules with the determined x_n at close to finite from step then the solution is to get the come, or x_n the world, for all *n* the world for the see can if, them do it near the addiction in the series established is

$$\lim_{n\to\infty} x_n = \xi;$$

2) the limit value $\xi\, f(x) = 0$ of the equation the solution is;
3) approach the speed of $|\xi - x_n| \le t^* - t_n$ disparity with charged, this earth t_n $P(t) = \frac{K}{2}t^2 - \frac{t}{B} + \frac{\eta}{B} = 0$ of the equation , a small root for $t_0 = 0$ and $t_1 = |x_1 - x_0|$ from the start of watar method with seen the series near.

Example.

$$f(x) = x^4 - 3x^3 + x - 2$$

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of the equation is positive, the root of the accuracy with found.

Of charging.

$$f(x) = x^4 - 3x^3 + x - 2$$

1. Starting point we choose

The root is positive, that is said, so for we the following points test , we see:

$$x_0 = 1 \quad x_1 = 2$$

Consider:

$$f(1) = 1^4 - 3 \cdot 1^3 + 1 - 2 = -3$$

$$f(2) = 2^4 - 3 \cdot 2^3 + 2 - 2 = -8$$

Both the value is also negative, the root of this range are not.

Homeqa range do not look at

$$x_0 = 2 \quad x_1 = 3$$

Consider:

$$f(2) = 2^4 - 3 \cdot 2^3 + 2 - 2 = -8$$

$$f(3) = 3^4 - 3 \cdot 3^3 + 3 - 2 = 1$$

This interval in the root is there.

Watar the method of the formula:

$$x_{n+1} = x_n - f(x_n) \cdot \frac{x_n - x_{n-1}}{f(x_n) - f(x_{n-1})}$$

1- iteration

$$x_0 = 2 \quad f(2) = -8$$

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$x_1 = 3 \quad f(3) = 1$

$$x_2 = \frac{2 \cdot 1 - 3 \cdot (-8)}{1 - (-8)} = \frac{26}{9} \approx 2.8889$$

Consider:

$f(2.8889) \approx 2.8889^4 - 3 \cdot 2.8889^3 + 2.8889 - 2 = 0.695$

Now a new space of appearance was: $x_0 = 2 \quad x_2 = 2.8889$

$f(x_0) = -8$

$f(x_2) = 0.695$

2- iteration in the above formula when following the answer we get:

$x_3 = 2.817$

$f(2.817) \approx 0.285$: ,

Hence iteration implementation found we can

3- iteration

$x_4 \approx 2.789 \quad f(2.789) \approx 0.095$

4- iteration

$x_5 \approx 2.768 \quad f(2.768) \approx 0.035$

5- iteration

$x_6 \approx 2.759 \quad f(x_6) \approx 0.012$

6- iteration

$x_7 \approx 2.755 \quad f(x_7) \approx 0.004$

7- iteration

$x_8 \approx 2.753 \quad f(x_8) \approx 0.0012$

8- iteration

$x_9 \approx 2.752 \quad f(x_9) \approx 0.0003$

This earth $f(x) \approx 0.0003 < \varepsilon = 0.0001$ that beneficially, the solution accuracy with found.

The results positive root:

$x = 2.752$

Conclusion

This article considers the method of vectors used in the process of solving equations by numerical methods. The mathematical essence, principle of operation and general algorithm of the method are analyzed, and the necessary conditions for its application are highlighted. The method of vectors has a simple structure and is considered a practical and effective method since it does not require derivatives in calculations. The method is algorithmically simple and suitable for automation through programming. It approaches the root based on the starting points during the calculation process and gives a fairly accurate result. This method is one of the reliable numerical methods that can be widely used in mathematical modeling, technical calculations and scientific research.

Used literature

1. Karimov A.K., Tursunov A.T. Computational Mathematics. – Tashkent: «Science and Technology», 2018.

2. Rashidov M.A. Numerical Methods. – Tashkent: Ministry of Higher and Secondary Specialized Education of the Republic of Uzbekistan, 2019.

ISSN 2181-3187

3. Burden R.L., Faires J.D. Numerical Analysis. – Boston: Cengage Learning, 2011.

4. Atkinson K.E. An Introduction to Numerical Analysis. – Wiley, 2004.

5. Lutz M. Python Programming Language. Beginner's Guide. – Tashkent: INNOVATSION NASHRIYOT, 2022

6. Chapra S.C., Canale R.P. Applied Numerical Methods with Python for Engineers and Scientists. – McGraw-Hill Education, 2021.