The Basic Properties Of Injectance

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***Abstract*—By comparing two or more mathematical sizes, standard education introduces us to the very beginning of education. There are several types of inequalities of linear, quadratic, polynomial, logarithmic, geometric, trigonometric,**

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I. INTRODUCTION

Inequality is an important part of mathematics. We have met them from the very beginning with the simplest examples, such as the comparison of numbers where for the first time we encounter the concept of inequality, solve differences, more elaborate examples where something has to be shown. In such cases, some additional facts and characteristics must be used.

The application of inequality is present in mathematical analysis, geometry, probability theory, mathematical statistics, mathematical data processing, linear and dynamic programming, as well as in theoretical and applied mathematics.

Demonstration of inequality in mathematics is also a creative activity. The application of inequality requires a good knowledge of mathematics, rich ideas and methods. Persistence, patience and curiosity in solving tasks is necessary. It is interesting to prove inequality, but not easy. Something new, interesting and unexpected can always be added and concluded. In the area of inequality, a solution can be quickly reached by analysis and research, and sometimes deeper analysis is required. Evidence can be brief and concise, but also long, complicated[1]-[5].

II. APPLICATION OF INJUNCENCE

One of the problems that arise in solving tasks is determining the character of a given expression for all the values of the variables involved in it. The principle used to prove the given inequality is that, based on some obvious inequality, there is an inequality that needs to be proved.

Example 1.

$x^2 \geq 0$ for everyone $x \in R$

The square of an expression is always positive or equal to zero (for x = 0)

$\rightarrow x^2 + 4x + 4 = (x+2)^2 \geq 0$ for $\forall x \in R$

$\rightarrow -a^2 + 2a - 1 = -(a-1)^2 \leq 0$ for $\forall a \in R$

$\rightarrow x^2 - xy + y^2 \geq 0$ because

$$x^2 - xy + \left(\frac{y}{2}\right)^2 - \left(\frac{y}{2}\right) + y^2 = \left(x - \frac{y}{2}\right)^2 - \frac{y^2}{4} + y^2$$

$$= \left(x - \frac{y}{2}\right)^2 + \frac{3y^2}{4}$$

We've made a "full square" addition, so it's $\left(x - \frac{y}{2}\right)^2 \geq 0$ and $\frac{3y^2}{4} \geq 0$, and then their total is ≥ 0.

Example 2.

Prove that it is $\frac{x^2+y^2+z^2+3}{2} \geq x + y + z$

Solution: We are certain that it is valid

$$(x-1)^2 \geq 0$$
$$(y-1)^2 \geq 0$$
$$(z-1)^2 \geq 0$$

Let's pick these three inequalities**:**

$(x-1)^2 + (y-1)^2 + (z-1)^2 \geq 0$

$x^2 - 2x + 1 + y^2 - 2y + 1 + z^2 - 2z + 1 \geq 0$

$x^2 + y^2 + z^2 + 3 \geq 2x + 2y + 2z$

$x^2 + y^2 + z^2 + 3 \geq 2(x + y + z)$

$$\frac{x^2 + y^2 + z^2 + 3}{2} \geq x + y + z$$

And we proved what was needed.

III. LOGARITHMIC INJECTIONS

The word logarithm is derived from the Greek word logos = ratio and arithmos = number. With the rapid development of astronomy and sailing, logarithms began to apply in the XV and XVI centuries in numerical calculations.

In the application of logarithmic inequalities, attention must be paid to the defined domain. Inequalities are transformed into a more simple form using the properties of logarithms. Then the characteristics of monotonicity of logarithmic functions are used, when the function grows and decreases. The following is true:

1. If a > 1, then it is
$\log_a f(x) \leq \log_a g(x) \Leftrightarrow 0 < f(x) \leq g(x)$.

2. If 0< a < 1, then it is
$\log_a f(x) \leq \log_a g(x) \Leftrightarrow < f(x) \geq g(x) > 0$.

1. Check the accuracy of the inequality

$$< \; 2^{\sqrt{\log_2 2011}} \qquad 2011^{\sqrt{\log_{2011} 2}}$$

Solution: Logarithmation of the left and right side of the inequality, then using the logarithmic properties, provides a series of equivalent inequalities

$$\log 2^{\sqrt{\log_2 2011}} < \log 2011^{\sqrt{\log_{2011} 2}}$$

$$\sqrt{\log_2 2011} \cdot \log 2 < \sqrt{\log_{2011} 2} \cdot \log 2011,$$

$$\sqrt{\frac{\log 2011}{\log 2}} \cdot \log 2 < \sqrt{\frac{\log 2}{\log 2011}} \cdot \log 2011,$$

$$\sqrt{\log 2011 \cdot \log 2} < \sqrt{\log 2 \cdot \log 2011}.$$

The inaccuracy of numerical inequality was shown.

2. Prove inequality

$$(log_{2009} 2010 \;)^{-1} + (\log_{2011} 2010)^{-1} < 2$$

Solution:

By applying the degrees of stagnation and logarithm of the left side of the inequality becomes

$$\frac{1}{log_{2009} 2010} + \frac{1}{\log_{2011} 2010}$$
$$= \log_{2010} 2009 + \log_{2010} 2011$$
$$= \log_{2010}(2009 \cdot 2011)$$
$$= \log_{2010}(2010^2 - 1) < \log_{2010} 2010^2$$
$$= 2 \cdot \log_{2010} 2010 = 2.$$

3. Prove that for all natural numbers *n* is valid

$$\log(n+1) > \frac{\log 1 + \log 2 + \cdots . + \log n}{n}.$$

Solution:

Data inequality is equivalent to a series of following inequalities.

$$\log(n+1) > \frac{1}{n} \cdot (\log 1 + \log 2 + \cdots . + \log n),$$

$$\log(n+1) > \log(1\;2 \cdot \ldots . \cdot n)^{\frac{1}{n}},$$

$$\log(n+1) > \log(n!)^{\frac{1}{n}},$$

$$(n+1)^n > n!$$

4**. Geometric Inequalities**

A wide class of inequalities encountered in the applications of a geometric inequality. Under the geometric inequality, it is most often understood that inequality that is relevant to the elements of a triangle or some other geometric figure (cetvorogla, couples, rollers, balls, etc.).

4.1. Inequalities for triangle elements

Let the a, b, c sides of the triangle *ABC*, α, β, γ correspond to the angles of the triangle, h_a, h_b,h_c, corresponding to their height, t_a,t_b,t_c,adequate length of time,*r*i*R*, In the order of the semicircle, the triangles and the half-triangle are inscribed and described in the circles for the given triangle. We will prove some interesting inequalities that arise between these elements of an arbitrary triangle.

Example 4.1. Inequality

$$a^4 + b^4 + c^4 < 2(a^2b^2 + b^2c^2 + a^2c^2)$$

it is also necessary and sufficient condition for the duplication of the magnitudes of *a; b; c* can construct a triangle.
Solution: If we introduce labels $x = b + c - 1$, $y = a + c - b$, $z = a + b - c$,
Rešenje: Akouvedemooznake$x = b + c - 1$, $y = a + c - b$, $z = a + b - c$, then it is

$$a = \frac{y+z}{2}, \qquad b = \frac{x+z}{2}, \qquad c = \frac{x+y}{2}.$$

Now, inequality (4.1) can be written in an equivalent form

$$xyz(x + y + z) > 0, \text{ tj.}$$

$$(b + c - a)(c + a - b)(a + b - c)(a + b + c) > 0.$$

(⇒:) If they are a, b, c, length of pages of triangle, then it is

$b + c > a,\ a + c > b,\ a + b > c \Longrightarrow (b + c - a)(a + c - b)(a + b - c) > 0$,

from where follows inequality (4.2).

(⇐:) If there is an inequality (4.1), that is, (4.2), then as $a + b + c > 0$ we have two cases:

(i) $b + c > a, a + c > b, a + b > c$

or

(ii) two of the terms $b + c - a, a + c - b, a + b - c$ are negative.

If it applies (ii), e.g. $b + c \quad a > 0, a + c \quad b < 0, \quad a + b \quad c < 0$, adding the last two inequalities it turns out that $a < 0$, which is contrary to the assumption that a length is longer, ie, positive value. If vase (i), length a, b, c can be constructed triangle. Δ

IV. Conclusion

The themes covered are characterized by interest, diversity and applicability. The paper focuses on topics that are important for additional work, working with gifted students, as well as the competition of elementary and secondary school students. The combination of theoretical and practical research can serve as a good material to all who show interest in elementary inequalities and inequalities in general.

There is a need for strong motivation in the process of acquiring new knowledge, expanding and deepening the already acquired knowledge.

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