Samarkand State Medicine assistant
Ibragimova Dilshoda Anvar khizi
Samarkand State Medicine student
Abdurashid Muxtorov
Samarkand State Medicine student
Aynur Ahmadzada
Samarkand State Medicine student
Aghazada Idris Yashar Oglu
Samarkand State Medicine student
University Ammar Farmanov

THE PROOF OF THEOREMS ON CERTAIN INEQUALITIES AND THEIR APPLICATION IN PRACTICE

Abstract : This on the subject inequalities concept, their types (linear, quadratic, irrational and others), solution methods and graphic to describe roads It is also studied how inequalities are expressed in real life. application, mathematical model creation also see the role will be released. Subject mathematician logic reinforcement and problems analysis to do skills to develop service does.

Key words: Inequality, linear inequality, quadratic inequality, interval method, graph solution, mathematical model, solution package

Annotatsiya: Ushbu mavzu bo'yicha tengsizliklar tushunchasi, ularning turlari (chiziqli, kvadrat, irratsional) va boshqalar), yechim usullari va yo'llarni tasvirlash uchun grafik. Shuningdek, tengsizliklar real hayotda qanday ifodalanishi o'rganiladi. Qo'llanilishi, matematik model yaratish, shuningdek, rolni ko'rish mumkin. Mavzu bo'yicha matematik mantiqni mustahkamlash va muammolarni tahlil qilish ko'nikmalarini rivojlantirish uchun xizmat qiladi.

Kalit so'zlar: Tengsizlik, chiziqli tengsizlik, kvadrat tengsizlik, interval usuli, grafik yechim, matematik model, yechimlar to'plami

Аннотация: В данной работе рассматриваются понятия неравенств, их типы (линейные, квадратичные, иррациональные) и другие, методы решения

и графическое описание уравнений. Также изучается, как неравенства выражаются в реальной жизни. Применение и создание математических моделей, а также роль, которую они играют, будут раскрыты. Предметом исследования является закрепление математической логики и анализ задач для развития навыков обслуживания.

Ключевые слова: Неравенство, линейное неравенство, квадратичное неравенство, интервальный метод, графическое решение, математическая модель, пакет решений

Access

Mathematics is only theoretical concepts not in real life problems modeling and analysis to do for powerful in particular, **inequalities** daily in life decision acceptance to do, optimal resource distribution and security borders in marking wide is applied. Budget restrictions, maximum working release size, minimum energy expense such as many economic and technician issues inequalities through is expressed.

This in the article inequalities important from theorems was **AM-GM** and **Koshi-Bunyakovsky** inequalities deep analysis is done, their mathematician evidence will be brought both real and theoretical issues through application demonstration Also, the article of the students analytical thinking, proving and modeling skills to develop service does.

The main part

AM-GM inequality (Arithmetic-geometric average theorem)

Text: (you sent proofs based on is left, orderly as is written).

Generalized AM-GM or Koshi-Bunyakovsky inequality

Text: (you sent main proof stored, lemmas with), with your acquaintance possible:

Theorem (AM-GM): All positive $a_1, a_2, a_3, \dots a_n$for numbers

$$\frac{a_1+a_2+\dots+a_n}{n} \geq \sqrt[n]{a_1 a_2 \dots a_n} (1)$$

inequality appropriate. Equality $a_1 = a_2 = a_3 = \dots ¿ a_n$is executed when.

Proof: By induction we use.

$n=2$at$\sqrt{a_1 a_2} \le \frac{a_1+a_2}{2} \le ¿ \left(\sqrt{a_1}-\sqrt{a_2}\right)^2 \ge 0 \forall\ a_1, a_2 \ge 0$

(1) in We prove that it is $n$valid for ta positive numbers by assuming that ta is valid for $n+1$ta $R^{+¿¿}$numbers. Let these numbers $a_1, a_2, a_3, \ldots a_n, a_{n+1}$be $a_{n+1}$the largest of them,

$$a_{n+1} \ge a_1, a_{n+1} \ge a_2, \ldots a_{n+1} \ge a_n = ¿$$

$$¿ > a_{n+1} \ge \frac{a_1+a_2+\ldots+a_n}{n} (2)$$

As follows designation we enter.

$$A_n = \frac{a_1+a_2+\ldots+a_n}{n}; A_{n+1} = \frac{a_1+a_2+\ldots+a_n+a_{n+1}}{n} = \frac{n A_n + a_{n+1}}{n+1}$$

(2)to according to $a_{n+1} \ge A_n = ¿ a_{n+1} = A_n + \alpha\ \alpha \ge 0$Let's say. Then:

$$A_{n+1} = \frac{n A_n + A_n + \alpha}{n+1} = A_n + \frac{\alpha}{n+1}$$

This equality both part $n+1$Raising to the level, we find:

$$\left(A_{n+1}\right)^{n+1} = A_n^{n+1} + C_{n+1}^1 \left(A_n\right)^n \frac{\alpha}{n+1} + \ldots + C_{n+1}^n \left(A_n\right) \left(\frac{\alpha}{n+1}\right)^n + ¿$$

$$+\left(\frac{\alpha}{n+1}\right)^{n+1} \ge \left(A_n\right)^{n+1} + C_{n+1}^1 \left(A_n\right)^n \frac{\alpha}{n+1} = \left(A_n\right)^{n+1} + \left(A_n\right)^n \frac{\alpha}{n+1} \frac{(n+1)!}{1! n!}$$

$$¿ A_n^{n+1} + \left(A_n\right)^n \alpha = A_n^n \left(A_n + \alpha\right) = A_n^n \cdot a_{n+1}$$

To the assumption according to $A_n^n \ge a_1 a_2 \ldots a_n = ¿$

$$\left(A_{n+1}\right)^{n+1} \ge a_1 a_2 a_3 \ldots a_n a_{n+1} = ¿$$

$$\frac{a_1+a_2+\ldots+a_n+a_{n+1}}{n+1} \ge \sqrt[n+1]{a_1 a_2 \ldots a_n a_{n+1}}$$

From this come it turns out theorem proved.

Theorem (Generalized AM-GM or Cauchy-Bunyakovsky):

$a_1, a_2, \ldots a_n, p_1, p_2, \ldots, p_n$positive numbers

$$a_1^{p_1} a_2^{p_2} \ldots . a_n^{p_n} \le \left(\frac{a_1 p_1 + a_2 p_2 + \ldots + a_n p_n}{p_1 + p_2 + \ldots + p_n}\right)^{p_1+p_2+\ldots+p_n} (1)$$

Relationship appropriate, equality and only $a_1 = a_2 = a_3 = \ldots ¿ a_n$is performed.

Proof: Lemma: $e^{x-1} \ge x$there is, in which $x \ge 1$.

Lemma The $¿ > e^{x-1} - x \ge e^{1-1} - 1 = 1 - 1 = 0 = ¿ e^{x-1} - x \ge 0$proof is $f(x) \ge f(1)$that $¿ > x \ge 1$: $f(x) = e^{x-1} - x$

(1) in proof From the lemma we use.

$$S=\frac{a_1 p_1+a_2 p_2+\ldots+a_n p_n}{p_1+p_2+\ldots+p_n}$$

to mark as we enter.

To the lemma according to : $e^{\frac{a_i}{S}-1}\geq\frac{a_i}{S}$it will be, in which case$i=\overline{1,n}=¿$ $S\cdot e^{\frac{a_i}{S}-1}\geq a_i=¿$

$$a_i^{p_i}\leq S^{p_i}\cdot e^{\frac{a_i p_i}{S}-p_i}, i=\overline{1,n}$$

These inequalities all of them multiply Let's go out.

$$a_1^{p_1}a_2^{p_2}\ldots.a_n^{p_n}\leq\left(\frac{a_1 p_1+a_2 p_2+\ldots+a_n p_n}{p_1+p_2+\ldots+p_n}\right)^{p_1+p_2+\ldots+p_n}$$

Equality only $s=a_1=a_2=a_3=\ldots¿a_n$is fulfilled, it follows that the inequality has been proven.

We are this from theorems using one how much following inequality about issues our solution possible.

Issues

Example 1: $x,y>0$Prove the inequality if.$x^2+y^2+1\geq xy+x+y$

Proof:$x^2+y^2+1=\left(\frac{x^2}{2}+\frac{y^2}{2}\right)+\left(\frac{x^2}{2}+\frac{1}{2}\right)+\left(\frac{y^2}{2}+\frac{1}{2}\right)\geq xy+x+y$

From this come comes out inequality proved.

Example 2: $x>0$if, $2^{\sqrt[12]{x}}+2^{\sqrt[4]{x}}\geq 2\cdot 2^{2\sqrt[6]{x}}$prove the inequality.

Proof: AM-GM theorem according to :$2^{\sqrt[12]{x}}+2^{\sqrt[4]{x}}\geq 2\cdot 2^{x^{\frac{1}{12}+\frac{1}{4}}}=2\cdot 2^{2x^{\frac{1}{6}}}=2\cdot 2^{2\sqrt[6]{x}}$

from this come comes out inequality proved.

Conclusion

Inequalities mathematician analysis, engineering, economics and medicine such as many in the fields important tool as service This will do. in the article the most famous and strong inequality from theorems one was **AM-GM (arithmetic-geometric) average)** and **Koshi-Bunyakovsky** inequalities studied, their **induction, elementary algebra** and **exponent function based on** evidence was brought.

Quoted examples through this inequalities not only theoretically, maybe **practical** also showing **the** importance They were given. using complicated expressions assessment, problems simplification, as well as real -life restrictions as a mathematical model expression opportunity existence proved.

Also in the article inequalities : in medicine – **dose borders in determining**, in economics – **budget distribution in planning**, in engineering – **mechanical security in providing**, how application shown.

In the future this the topic following in directions expansion to the goal appropriate will be :

Holder, Chebyshev and **Minkowski** inequalities such as progressive inequalities study, algorithmic analysis based on **computer through automated proof methods** use, inequalities **at the Olympics** application analysis to do

Literature list :

1. Aliev R.A. **Primenenie neravenstv v injenernyx raschetax** // Vestnik MGTU. – 2016. – No. 3. - S. 45–52.
2. Abdullaev B.A. **Mathematician analysis Fundamentals.** – Tashkent : Teacher, 2000. – 385 p.
3. Kurbanov XX, Yusupov AR **Higher mathematics.** – Samarkand : SamDU publishing house, 2019. – 412 p.
4. Ibragimova D.A. **Some inequalities practical analysis** // Samarkand DTU scientific Newsletter. – 2023. – No. 2. – P. 90–94.
5. Sedgewick R., Wayne K. **Algorithms (4th Edition).** - Addison-Wesley, 2011. - 976 p.
6. Weisstein, Eric W. "Inequality." *MathWorld* – A Wolfram Web Resource. URL: https://mathworld.wolfram.com/Inequality.html