Mathematical Olympiads and their goals

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Mathematical Olympiads

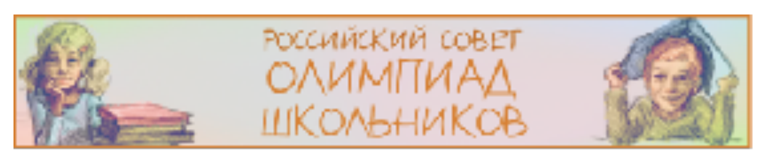
Science

Sport

University admission

Status

Летняя школа
«СОВРЕМЕННАЯ МАТЕМАТИКА»



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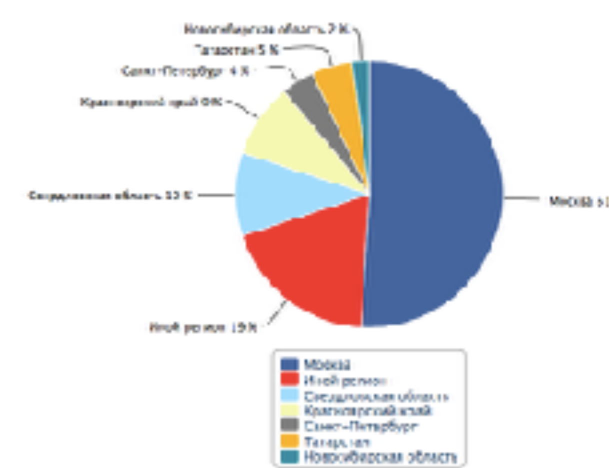
Олимпиады для школьников



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Всероссийская олимпиада школьников

РОССИЙСКИЙ СОВЕТ ОЛИМПИАД ШКОЛЬНИКОВ

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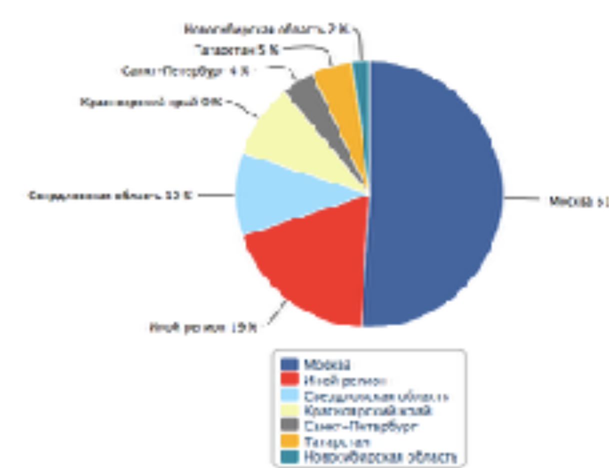

Plan

1. A brief history
2. Current crisis
    A. Substantive crisis
    B. Format crisis
    C. Ethical crisis
3. Measures to meet the crisis
4. A special experience
5. Ways to overcome the crisis

A brief history

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A brief history

1. XV-XVIII century: One-vs-one

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2. XIX century: Mass contests

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2. XIX century: Mass contests
3. XX century:

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3. XX century:
    A. Town contests

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    C. World contests

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3. XX century:
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    B. National contests
    C. World contests
4. XXI century: University admission contests (?!)

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Substantive crisis

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Substantive crisis

- Very few, almost none new ideas for the contest problems

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- Olympiads turned into a sport of combining standard ideas

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- Excluding real science from mathematical circles

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Substantive crisis

- **All-Union, 1962, grade 9 of 10:** Given a square table NxN with odd N, its each cell containing ±1, for every horizontal and vertical row we calculate the product of the numbers in this row. Prove that the sum of obtained 2N numbers is not equal to 0.

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- **All-Russian, 2015, grade 9 of 11:** Given N>8 different non-negative numbers, each less than 1, with the property that for every 8 numbers there exists 9th such that the sum of these nine numbers is integer, determine how many numbers could there be at least?

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17. Пусть $p_1, p_2, \dots, p_n$ — произведения по строкам, $q_1, q_2, \dots, q_n$ — по столбцам. Тогда $p_1 p_2 \dots p_n = q_1 q_2 \dots q_n$ — мы двумя способами вычисляем произведение всех чисел в таблице. Значит, четность количества -1 среди $p_1, p_2, \dots, p_n$ та же, что и среди $q_1, q_2, \dots, q_n$, т. е. всего среди $2n$ чисел $p_1, p_2, \dots, p_n, q_1, q_2, \dots, q_n$ четное число -1 и тем самым четное число $+1$. Но тогда число тех и других различно (так как n нечетно) и потому сумма $p_1 + p_2 + \dots + p_n + q_1 + q_2 + \dots + q_n$ не равна 0.

∇ Эта сумма может отличаться от $2n$ лишь на число d, кратное 4. Интересно, построив соответствующие примеры, выяснить, для любого ли $d = 4k$, $|k| < n/2$, сумма может равняться $2n - d$.

Substantive crisis

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- **All-Russian, 2015, grade 9 of 11:** Given $N>8$ different non-negative numbers, each less than 1, with the property that for every 8 numbers there exists 9th such that the sum of these nine numbers is integer, determine how many numbers could there be at least?

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Ясно, что при $N = 9$ требуемое возможно – достаточно написать на доску 9 различных положительных чисел с единичной суммой. Покажем, что при $N > 9$ требуемое невозможно.

Предположим противное; обозначим через S сумму всех чисел на доске. Выберем на доске произвольные числа $\alpha_1, \alpha_2, \ldots, \alpha_7$ с суммой T; пусть A – множество всех остальных чисел на доске. По условию, для любого числа $\beta \in A$ найдётся такое отличное от него число $\gamma \in A$, что число $T + \beta + \gamma$ целое. Скажем, что число γ *соответствует* числу β. Заметим, что такое число γ единственно. Действительно, если бы нашлось другое число $\gamma' \in A$, для которого сумма $T + \beta + \gamma'$ целая, то число $\gamma - \gamma' = (T + \beta + \gamma) - (T + \beta + \gamma')$ также было бы целым. Но это невозможно, ибо $0 < |\gamma - \gamma'| < 1$.

В частности, отсюда следует, что β соответствует числу γ. Значит, все числа в A разбиваются на пары чисел $(\beta_1, \gamma_1), \ldots, (\beta_l, \gamma_l)$ соответствующих друг другу. При этом
$l > 1$, так как $N = 7 + 2l > 9$.

Рассмотрим сумму $\Sigma = (T + \beta_1 + \gamma_1) + (T + \beta_2 + \gamma_2) + \ldots + (T + \beta_l + \gamma_l)$. Σ – целое число. С другой стороны, каждое число из A входит в Σ ровно по разу; значит,
$\Sigma = lT + (S - T) = S + (l - 1)T$, откуда $T = \frac{\Sigma - S}{l - 1}$.

Выбрав теперь на доске числа $\alpha_2, \alpha_3, \ldots, \alpha_8$ и обозначив их сумму через T', аналогично получим, что $T' = \frac{\Sigma' - S}{l - 1}$ при целом Σ'. Значит, $\alpha_1 - \alpha_8 = \frac{\Sigma - S}{l - 1} - \frac{\Sigma' - S}{l - 1} = \frac{\Sigma - \Sigma'}{l - 1}$.

Так как α_1 и α_8 могли быть любыми двумя числами на доске, получаем, что разность каждых двух чисел на доске имеет вид $\frac{k}{l - 1}$ при целом k.

Пусть μ – наименьшее число на доске. Тогда на доске могут присутствовать лишь числа $\mu, \mu + \frac{1}{l - 1}, \ldots, \mu + \frac{l - 2}{l - 1}$ (все большие числа будут уже не меньше 1) – всего l чисел. Однако общее количество чисел на доске равно $N = 7 + 2l > l$; значит, они не могут быть различными. Противоречие.

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Format crisis

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Format crisis

- Contests instead of entrance examinations

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Format crisis

- Contests instead of entrance examinations
- Special courses for solving Olympiad problems

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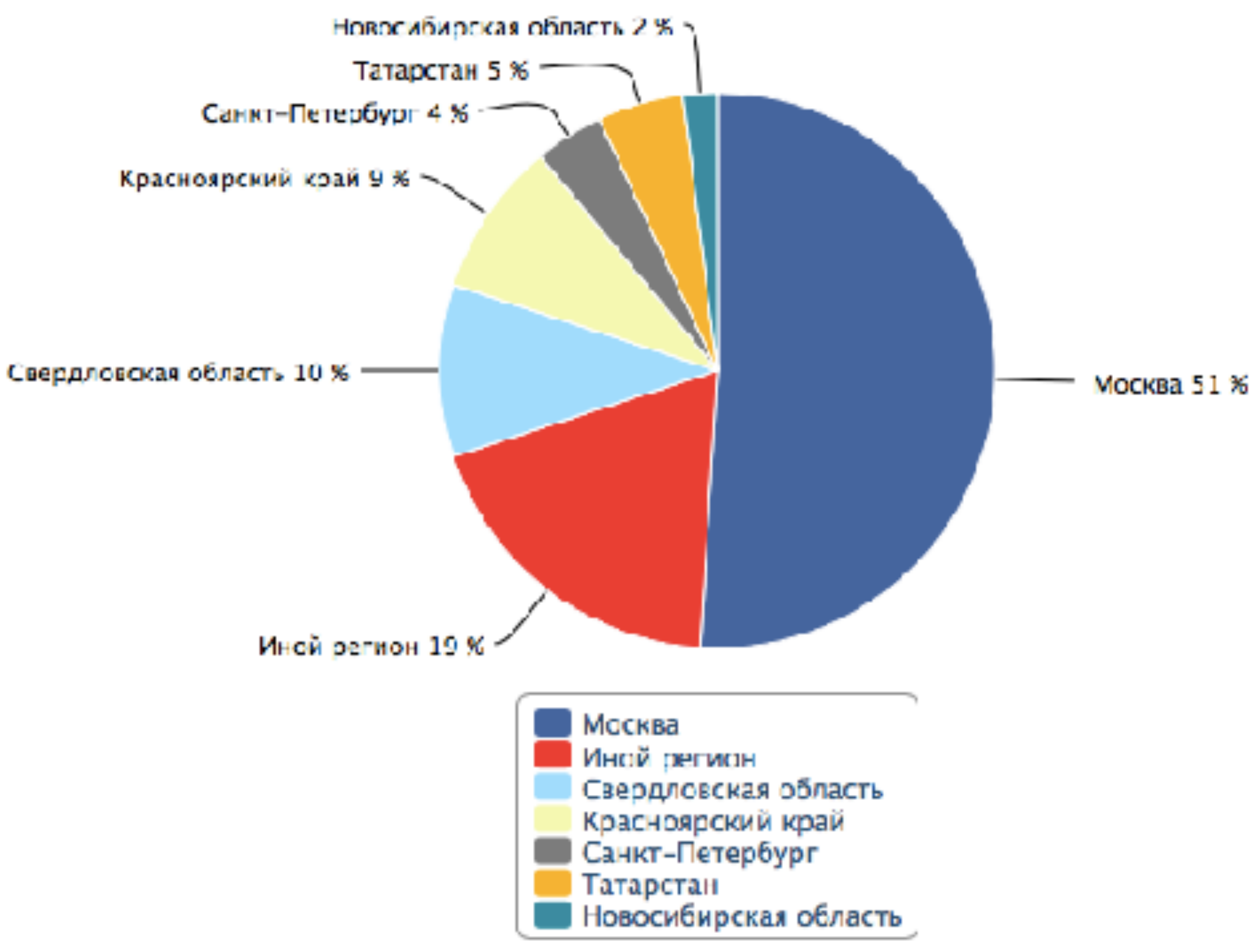
Format crisis

- Contests instead of entrance examinations
- Special courses for solving Olympiad problems
- Parents start to train their children too early

Ethical crisis

- The profit from the winning goes not only to the participant, but also to his coach and his school, thus impacting the relations



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Measures to meet the crisis

A. Inviting researchers, organising workshops

Летняя школа
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Measures to meet the crisis

B. Arranging the List and assigning the levels

#	Название олимпиады по математике	№ в перечне	Профиль	Уровень
1	Всероссийская олимпиада школьников «Нанотехнологии - прорыв в будущее»	7	нанотехнологии	1
2	Межрегиональная олимпиада школьников «Высшая проба»	28	математика	1
3	Межрегиональная олимпиада школьников по математике и криптографии	33	математика	1
4	Московская олимпиада школьников	41	математика	1
5	Олимпиада школьников «Ломоносов»	53	математика	1
6	Олимпиада школьников «Покори Воробьёвы горы!»	55	математика	1
7	Олимпиада школьников Санкт-Петербургского государственного университета	60	математика	1
8	Санкт-Петербургская олимпиада школьников по математике	77	математика	1
9	Турнир городов	84	математика	1
10	Всесибирская открытая олимпиада школьников	13	математика	2
11	Московская олимпиада школьников	29	математика	2
12	Межрегиональная олимпиада школьников на базе ведомственных образовательных учреждений	31	математика	2
13	Объединённая межвузовская математическая олимпиада школьников	43	математика	2
14	Объединённая международная математическая олимпиада «Формула Единства» / «Третье тысячелетие»	44	математика	2
15	Олимпиада Курчатов	46	математика	2
16	Открытая олимпиада школьников по математике	67	математика	2
17	Отраслевая физико-математическая олимпиада школьников «Росатом»	71	математика	2
18	Турнир имени М. В. Ломоносова	85	математика	2
19	Турнир имени М. В. Ломоносова	85	лингвистика	2
20	Олимпиада школьников «Физтех»	87	математика	2
21	Всероссийский конкурс научных работ школьников «Юниор»	10	математика	3
22	Межрегиональная олимпиада школьников «Будущие исследователи – будущее науки»	27	математика	3
23	Олимпиада школьников «САММАТ»	29	математика	3
24	Олимпиада по дискретной математике и теоретической информатике	49	математика	3
25	Олимпиада школьников «Надежда энергетики»	54	математика	3
26	Олимпиада юношеской математической школы	61	математика	3
27	Северо-Восточная олимпиада школьников	63	математика	3
28	Открытая Олимпиада Университета Иннополис для школьников	65	математика	3
29	Межрегиональная отраслевая олимпиада «Паруса надежды»	72	математика	3

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Measures to meet the crisis

C. Dividing the scores, having the right to choose the school

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A special experience

Mathematical all-around

Individual and team competitions

Algebra & NT
Geometry
Combinatorics & logics
Mathematical race
Team Olympiad

Popular lectures

Every member of the methodological board delivers a lecture on his favourite topic

Everyone is a winner

Most of the participants gain awards in one of the competitions

Experimental round

New forms of competitions

Arbitrary teams

Ways to overcome the crisis

A. Cooperation between researchers and Olympiad managers

B. Understanding the true sense of Olympiads

C. Reducing the role of the school and the teacher

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Thank you for your attention!

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«Phystech-lyceum» school http://ftl.name

QUESTIONS

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A. How to bring new fresh ideas to competition problems and make them more like science?

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B. What is the real meaning and purpose of mathematical competitions?

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A. How to bring new fresh ideas to competition problems and make them more like science?

B. What is the real meaning and purpose of mathematical competitions?

C. What kind of recognition should be implemented for teachers and schools?