

EGMO 2025 UK Deputy Leader's Report

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11-17 April 2025

The European Girls' Mathematical Olympiad is an annual mathematics competition in the Olympiad style for secondary school and sixth form girls. Its 14th edition was held from the 11th to the 17th April 2025 in Pristina, Kosovo. This is a report on the competition from the perspective of the Deputy Leader.

The UK Delegation

UNK Leader	Kasia Warburton
UNK Deputy Leader	Emily Beatty
UNK Observer C	Ava Yeo
UNK1	Aanya Goyal
UNK2	Julia Strekopytov
UNK3	Nanako Ueda
UNK4	Aurelia Walker
Team Guide	Mjellma

Problems

A note to any students trying these problems: it is best to have a very, very long go at them before looking for hints and solutions. With that in mind, I won't include any discussions or solutions of the problems in this report.

Day 1

Problem 1. For a positive integer N , let $c_1 < c_2 < \dots < c_m$ be all the positive integers less than N that are coprime to N . Find all $N \geq 3$ such that

$$\gcd(N, c_i + c_{i+1}) \neq 1$$

for all $1 \leq i < m$.

Problem 2. An infinite increasing sequence $a_1 < a_2 < a_3 < \dots$ of positive integers is called *central* if for every positive integer n , the arithmetic mean of the first a_n terms of the sequence is equal to a_n . Show that there exists an infinite sequence b_1, b_2, b_3, \dots of positive integers such that for every central sequence a_1, a_2, a_3, \dots , there are infinitely many positive integers n with $a_n = b_n$.

Problem 3. Let ABC be an acute triangle. Points B, D, E , and C lie on a line in this order and satisfy $BD = DE = EC$. Let M and N be the midpoints of AD and AE , respectively. Suppose triangle ADE is acute, and let H be its orthocentre. Points P and Q lie on lines BM and CN , respectively, such that D, H, M , and P are concyclic and pairwise different, and E, H, N , and Q are concyclic and pairwise different. Prove that P, Q, M , and N are concyclic.

Day 2

Problem 4. Let ABC be an acute triangle with incentre I and $AB \neq AC$. Let lines BI and CI intersect the circumcircle of ABC at $P \neq B$ and $Q \neq C$, respectively. Consider points R and S such that $AQRB$ and $ACSP$

are parallelograms (with $AQ \parallel RB$, $AB \parallel QR$, $AC \parallel SP$, and $AP \parallel CS$). Let T be the point of intersection of lines RB and SC . Prove that points R, S, T , and I are concyclic.

Problem 5. Let $n > 1$ be an integer. In a *configuration* of an $n \times n$ board, each of the n^2 cells contains an arrow, either pointing up, down, left, or right. Given a starting configuration, Turbo the snail starts in one of the cells of the board and travels from cell to cell. In each move, Turbo moves one square unit in the direction indicated by the arrow in her cell (possibly leaving the board). After each move, the arrows in all of the cells rotate 90° counterclockwise. We call a cell *good* if, starting from that cell, Turbo visits each cell of the board exactly once, without leaving the board, and returns to her initial cell at the end. Determine, in terms of n , the maximum number of good cells over all possible starting configurations.

Problem 6. In each cell of a 2025×2025 board, a nonnegative real number is written in such a way that the sum of the numbers in each row is equal to 1, and the sum of the numbers in each column is equal to 1. Define r_i to be the largest value in row i , and let $R = r_1 + r_2 + \dots + r_{2025}$. Similarly, define c_i to be the largest value in column i , and let $C = c_1 + c_2 + \dots + c_{2025}$. What is the largest possible value of $R + C$?

Results

Code	Contestant	P1	P2	P3	P4	P5	P6	Total	Result
UNK1	Aanya Goyal	7	7	0	7	1	0	22	Silver Medal
UNK2	Julia Strekopytov	5	0	0	7	2	0	14	Honourable Mention
UNK3	Nanako Ueda	7	7	1	7	5	0	27	Gold Medal
UNK4	Aurelia Walker	7	7	1	7	4	0	26	Silver Medal

What’s not reflected in these scores is the clarity and accuracy of the girls’ solutions: gone are the combinatorial essays and vague waffling of the younger students. These 4 have learned how to clearly formulate, structure, and communicate a mathematical argument which is a skill that will serve them very well in the future and allow them to hit the ground running when they start university in the autumn. It’s also nice to see the consistency in solutions. Full marks on Problem 4 and almost full marks on Problem 1 is always a good sign: it means that the girls have been putting in consistent effort throughout the year and that the UK’s training programme is hitting the right areas.

Daily Diary

Day -1: Wednesday 9th April, 2025

My EGMO starts a day before the girls’. I’m currently in the US for a 3-month research programme at UCLA as part of my PhD, so my first leg of travelling is an overnight flight from Los Angeles to London. By some miracle, my seat is the only one occupied in its row of four, so I get to stretch out horizontally and spend 7 of the 10 hours of the flight asleep.

Day 0: Thursday 10th April, 2025

We make our way to the Luton Airport Premier Inn one by one, with myself and Aurelia arriving first and the other girls and Ava a bit later. The girls are absolutely buzzing with excitement. We head to the nearby restaurant for some tea. A couple of the girls decide to order their mains from the kids’ menu to keep things simple and this turns out to be a great idea: all six of us order from the kids’ menu for pudding.

We chat about a million things over tea: the girls’ experience at Trinity Camp, the Swiss MO Instagram page¹, the political situation in Kosovo and the importance of cultural sensitivity, and our expectations of them for the exams (namely that they try their very best and enjoy the problems). Kasia arrives around 9PM and we head to our rooms with a promise of a very early morning.

¹See @swiss.mo for high quality Olympiad-related content

Day 1: Friday 11th April, 2025

Our first official day of EGMO begins at 3:30AM when my alarm goes off. After a quick coffee I go down to check the girls are all awake, and at 4AM we pile into the taxi that Ava had ordered the night before. Check-in and security go very smoothly. The only option for a direct flight from the UK to Kosovo on this day is a WizzAir flight from Luton to Pristina at 6:20AM, so after the traditional Pret-A-Manger breakfast we head to the gate and catch up on some much-needed sleep on the plane.

We land at around 10:30AM, and head out with our luggage to find the EGMO guides waiting for us at arrivals. The girls and Kasia are quickly asked to take part in an interview with Kosovar news. The girls talk eloquently about their excitement to be in the country, for the competition, and to meet the other teams, and Kasia firmly asserts her expectations that the girls do their best and have fun. The minibus is there to meet us as we exit and we head straight to the hotel. We're far too early for check-in so not all of the rooms are ready immediately. Ava offers to store some luggage in her room but in the time it takes for us to go up to her room and back down they've managed to arrange the rest of the rooms. We then go out for a walk with our Team Guide, Mjellma. We quickly learn that she is absolutely brilliant at being a guide, and that she either knows everything we need to know or can find out within two minutes. She and a couple of other guides take us on a short walk around the local area, to a park with a war memorial, some of the university buildings, and the town square. We learn a bit about Kosovo's history and symbolism from jewellery-shop windows. It's clear that hosting EGMO is a prestigious event for the young nation.

We head back to the hotel for lunch. Thankfully the food is familiar, varied, and tasty, so there's something for everyone. I can't say much about the afternoon: we leave the girls socialising with the Australians and I have a long nap. Kasia joins us for tea at the hotel, where the girls are invited to eat with the French team and the three adults discuss the ins and outs of the UKMT and the IMO. We head back up to my room to sign Aanya's birthday card for tomorrow and say goodnight.

Day 2: Saturday 12th April, 2025

We start the day with a nice breakfast and a punctual bus ride to the Opening Ceremony. All the main events - opening and closing ceremonies, and exams - are held at the Klan Arena just outside of town. The opening ceremony is quite low-key, and the speeches follow a very polite pattern of acknowledging every single type of guest before going into what needs to be said. There's some nice music from a band blending traditional instruments and electric guitars which is truly beautiful. I once again score poorly on Opening Ceremony Bingo: there is no traditional dancing, everybody knows what they're talking about, and only one speech in Albanian which I quickly realise is subtitled in English on the screen behind. The standard parade of countries is replaced by a "stand up and wave your flag"-chain of countries. Ava and I are sat around a corner from the students so we can't actually see all of them. Kosovo, Ukraine, and the US get the biggest cheers as expected.

After lunch I have another nap, while the girls go out for a longer city tour with the guides. Ava and I head out in the evening to grab snacks for the girls tomorrow, ranging from the very vague "juice" to the very specific "85% dark chocolate" which we find. I have a super-nice shower in the hotel then head to bed.

Day 3: Sunday 13th April, 2025

The day starts off quite well, with an early breakfast and a quick pep talk to remind the girls that they're great at maths and capable of doing very well, even though international competitions are daunting. We get on the coaches to the arena at 7:15AM.

Unfortunately, the setup for the competition has been greatly delayed. It turns out that Kasia had spotted an edge case in one of the questions at 10PM the night before, prompting many hours of re-writing, re-translating, and re-approving by the Jury. Most leaders went to bed around 2AM. This delay has carried over to this morning, where the guides have been frantically setting up all night and replacing the old versions of the paper with the new one. They're still going when we arrive at around 7:50AM. There's no chance of the exam starting at its planned time of 8:30AM. At 9AM they finally begin to let teams in to the building.

There is clearly a lot of pressure on the organisers to deliver an excellent EGMO, and they're keen to ensure that any attempt at cheating is rendered impossible. This means pre-exam checks take a very long time; teams are let in one by one, belongings meticulously searched, over the course of 45 minutes. This is in alphabetical order: the Aussies nearly first, the UK nearly last. The stress this causes the girls is obvious, having prepared mentally for an 8:30AM start, so I try running a little stretching warm-up and doing a few visualisation exercises to calm the nerves.

The girls are let in at 9:45AM, and the exam itself starts at 10AM. Us deputies try the problems together in a side room: Problem 1 seems very appropriate, Problem 2 is similarly appropriate, and Problem 3 is fiendish. At around 3PM our ravenous girls emerge, in a mix of spirits about the maths and all despairing about the exam conditions. Lunch has thankfully been delivered to the arena. Between mouthfuls the girls explain exactly what happened in the exam: around twenty deafening announcements about minor issues, no clock visible half the time, waits of an hour and fifteen minutes to go to the bathroom, and being shouted at in Albanian for not packing their papers into their envelopes fast enough. Most of these come down to a draconian approach to cheating prevention. I hear murmurs and snippets of these same issues, and a few others, from other students and deputies.

After lunch we get on the bus to the hotel, arriving at around 4:30PM. The girls are keen to get some rest and then go for a walk later, so I head to my room to contact the organisers about the issues in the exam. I ask Kasia to put me in contact with one of the EGMO board, and over the course of our phonecall it becomes clear that she's already aware of most of the things raised. A few things are new to her, so we clarify the details, but the majority of the issues are already in hand. When that's done I take two of the girls for a circuit of the local park before they're whisked away to a dinner with the sponsors.

After tea and a trip to the leaders' hotel, I sit down with Kasia and some of the other leaders to play cards before the scripts arrive at 10PM. This is a significant improvement on the 2AM of Georgia last year. It looks like the girls were pretty accurate in their assessment of what happened: Aanya's geometry attempt is marked harshly, but there are no fake-solves and the arguments are clear. Halfway through Kasia shows me the summary of the invigilation meeting sent to all leaders. This, thankfully, addresses the vast majority of the issues raised by the students across all countries and gives us a lot more confidence for the next day. I head back at around midnight. The taxi driver is very nice, but I unfortunately manage to upset him when writing the receipt, showing him the 5€ note I gave him and the eighty cents he gave me as change to prove that the 4.20€ I wrote on the receipt was correct. The police have a go at him for taking so long in the hotel driveway. I hurriedly agree to take a receipt for 4.70€ and head to bed.

Day 4: Monday 14th April, 2025

Breakfast and travel arrangements are the same as the day before, and I give the girls the summary of the invigilation meeting which does a lot for the nerves. The setup for the exam is so much calmer today, and the girls can enter freely. We do a few more quick stretches before the girls go into the exam hall at 8:20AM. I head back up to the deputies' room with all the girls' belongings, and spend a bit more time on marking before we hear that the exam has started. It's at this point I start to believe that we didn't escape the curse of fake-solves yesterday: Nanako's solution to Problem 2 starts off with a great idea, but it appears she's missed a small check in her inductive argument which causes the actual claim she's made to be false. This is very unfortunate.

I tackle the problems for today: Problem 4 is some standard geometry, Problem 5 sees the return of the beloved Turbo for some combinatorics, and Problem 6 is some difficult algebra which I'm sure must have emerged from a research problem (because lots of people care about properties of bistochastic matrices). My solution to Problem 5 is a disgusting 16-case bash but the Norwegian and Danish deputies have a pretty elegant argument that they tell me isn't too difficult to find.

The girls come out of the exam in far better spirits than the day before. Everyone is claiming to have solved the geometry and made some progress on the combinatorics, and (most importantly) they're all gushing about how much nicer the exam was today. It's very impressive that Kosovo's organisers have fixed every single issue from yesterday to deliver a near-perfect exam in the space of a day. An international event on this scale is impossible to run without a few hiccups, but what matters most is how those hiccups are handled, and this year's hiccups have been handled excellently.

The day's memes from the Swiss MO instagram are already out, and they're beautiful. We have a good giggle. We (on the bus) race Kasia (walking from one hotel to the other) back and meet her as she arrives. The two of us go up to my room for some markscheme discussion. We re-read Nanako's script to find that, actually, her Problem 2 solution is perfect: she's just used the same notation j for two different things in two different places and this makes the whole argument appear wrong. We then have naps, have a slightly delirious ramble about all sorts, and go down for tea.

A taxi back to the leaders' hotel after tea gets us there just after scripts arrive for Day 2. It seems the Trinity Camp write-up clinic has worked wonders. The scripts are brilliantly written and so marking is super speedy: scripts received at 9PM and I'm back at my own hotel by 11PM.

Day 5, Tuesday 15th April, 2025

This is my third year at EGMO, and so coordination day is fairly familiar. We arrive early and go straight in to coordinate in empty slots, especially for the easy problems (all 7s on Problem 4, all 0s on Problem 6, etc.) We have a very long discussion about Problem 5 and are told to come back later. By lunchtime we have coordinated all problems except Problem 5, which is a huge win. We have a nice lunch organised by Jane Street who are sponsoring both EGMO and the UK team. However, by this time it's clear that Problem 5 coordination will go on long into the evening. In particular:

- We had been sent away from coordination at 10AM to look for evidence of a proof of a very specific, fairly obvious statement. We had been given a list of 'acceptable' forms of proof that would work.
- We hear that the coordinators had a 2-hour long discussion about how to mark this, followed by a vote, followed by a 1-hour long debate about whether the vote was correct. Their interpretation of the markscheme is, in my subjective opinion, incredibly harsh.
- We establish that one of our scripts definitely hits their standard of proof, two probably don't, and the last one definitely proves it to any *reasonable* standard, but we'd have to argue well that it proves it to *their* standard.
- We find that one of the New Zealand (NZL) scripts, which has an argument identical to our contentious script but of higher quality by an amount $\epsilon > 0$, which has been awarded the mark. We vow to use this as an argument why ours is also worth the mark.
- As more leaders emerge, it's obvious that almost everyone has lost this mark. There are a lot of angry, frustrated, and confused leaders. It's important to remember at this point that the coordinators were each running on about 2 hours of sleep: they didn't get to start marking until 11PM.
- I spend the afternoon chilling out, sewing, and giving some of the Irish scripts a once-over at Fionn's request. They have a script which proves this statement at a quality $\epsilon > 0$ less than our contentious script, so we have a third one to add to the pile.
- The NZL leaders get summoned back to coordination - we assume this is to try and dock them the relevant mark on Problem 5, but it's actually to give them an extra mark on Problem 1.
- The NZL leaders get summoned back *again*, this time to really dock them the mark. After this we concede defeat and accept the lowered mark for our contentious script.
- We work out that there are only 2 people so far today who have been given the full 7 marks. This makes it seem a little less ridiculous: it's silly, but it's consistent, and if everyone loses a mark then the medal boundaries are just lowered by 1.

Kasia and I head back to the hotel to talk to the girls and have tea. By this time all coordination is done except for Problem 5. Some teams have been rescheduled for around 1:30AM, and so the final Jury meeting is postponed to the next morning.

Day 6: Wednesday 16th April, 2025

I accidentally sleep through breakfast and get straight on a bus with the other deputies to the leaders' hotel; Kasia has snuck a croissant into the final Jury meeting for me. We spend a long time discussing proposed changes to the regulations before moving onto the reports from the Chief Invigilator, Chief Coordinator, and Appeals Committee. It's noted that the Appeals Committee has seen increasing use over the last few years, which is not really a good thing - an appeal is a last resort, and most years would ideally see zero appeals.

We end by voting on the medal boundaries: the choice for silver is pretty obvious, but there's a vote between 15 and 16 for bronze and 27 and 28 for gold. We are hoping for 16 for bronze as Julia has 14 points, and being one mark off a medal is mentally the second-worst mark to get (after 0 points). Unfortunately for us (but fortunately for the 4 girls on 15), the boundary is chosen at 15. More fortunately, there's a clear majority choosing 27 for the upper boundary, meaning Nanako scrapes a gold medal.

We make up for the missed excursion by heading out for lunch at a local bakery with some of the other leaders. The very nice barber from next door translates for us, and we have a wonderful mix of mastia (doughy meatballs),

pitë (puff pastry, feta, and spinach roll), and flia (pancakes and feta stacked into a pie). We walk back to the hotel, get changed quickly, and head out for the Closing Ceremony.

One of our girls has made a Closing Ceremony Bingo card that has made its way around many of the contestants. “Mascots being stolen”, “mascots getting married”, “a speech in Albanian”, “confusing handover to France”, and “not enough room on stage” all get ticked off. Italy have won the European contest for the first time ever, which is a huge achievement. In general the whole ceremony runs smoothly and the afterparty is the perfect chance to relax, celebrate everyone’s success, and say goodbye for another year.

Day 7: Thursday 17th April, 2025

We get up at a semi-reasonable time for the bus to the airport. We give Mjellma her gift to say thanks and she gives us back a tasty packed lunch of flia and pitë to take on the plane. The flight is uneventful: I do some sewing, the girls make some bracelets, and we say goodbye at Luton.

Notes on the Final Jury Meeting

- **EGMO 2027:** The 16th European Girls Mathematical Olympiad will be held in Šibenik, Croatia. They have managed to arrange for the exam to be held in the hotel, which avoids lots of lengthy bus rides on exam days.
- **Eligibility:** EGMO eligibility has been aligned with IMO eligibility in terms of schooling and citizenship requirements.
- **Coordination of host countries:** Previously, the country submitting a problem was required to coordinate the host country’s scripts. EGMO now has enough international coordinators that this is no longer needed: leaders and deputy leaders of countries submitting problems will now only be required to coordinate the host country if no pair of international coordinators are available or if it is necessary to avoid a conflict of interest. This should help encourage more countries to submit problems.
- **Conflict:** An anonymous survey will be held after EGMO to discuss how implications of conflict (that is, international political conflict, and not leaders having beef with one another as I unfortunately had to ask to clarify) are handled at EGMO.
- **EGMO vs IGMO:** The international representative to the EGMO Board gave a presentation on a proposed discussion to make EGMO more formally “international”: the main motivation for this seemed to be the undue burden placed on non-European participants by registration fees and flights. It appears that funding is a barrier to many countries’ participation and that the fees have increased a lot in recent years. There is a very long discussion about the implications of this: whether this would cause EGMO to lose its identity and become a sort of “knockoff IMO”, the burden then placed on small European countries if flight costs make a trip outside Europe unaffordable, and pressure on host countries in terms of funding. I realise later that broadening EGMO from a European competition to “the” international one would also seriously undermine PAGMO². No action is taken immediately, but the whole discussion is very productive and the door is left wide open for discussions about fee reductions and support for international teams between now and the next EGMO.
- **Female coordinators:** A fairly heated discussion about the gender balance in coordination at EGMO follows. Many countries at EGMO have a tradition of sending female leaders and deputies, and the EGMO board is very female-heavy, but the coordination and problem selection committee roles are still incredibly male-dominated. I won’t give details of the discussion here, and no formal action is taken, but everyone seems very keen to support future host countries to achieve a good gender balance among coordinators.
- **EGMO Board:** Viviane’s and Lyuba’s terms on the EGMO board come to an end, and I put myself forward as a new member of the board. I am elected against a fierce competition of exactly zero other people. I’m very excited to help shape the future of EGMO, support countries throughout the year, and continue the great success of the event for the next three years.
- **Markschemes and coordination:** The timescale for coordinators writing markschemes, leaders understanding them, and voting to approve them, is very short. This year the first Jury meeting happened in the

²Pan-American Girls’ Mathematical Olympiad, est. 2021.

afternoon of the second day where the papers were approved, coordinators worked on markschemes during the night to get them done by the end of the Q&A on Day 3, at which point they were shown to the leaders and voted on almost immediately. It is this rush that partly caused the issues with the marking of Problem 5 this year. There is, unfortunately, no good solution: markschemes take both time to write and time to understand, neither of which we have. A few good suggestions on how to ease the tension came up and were given to France to mull over for next year.

Final remarks

I owe a huge number of thanks to a number of people for the success of this EGMO. Firstly to those behind the event: the organisers in Kosovo, the problem selection committee and the coordinators, Jane Street for their generous and continued sponsorship of the UK team, and to the UKMT office for the organisation. Secondly to those with me: to Kasia and Ava for being wonderful travelling companions and even more wonderful friends, and to Julia, Aurelia, Aanya, and Nanako for being an amazing team and for listening to (most of) what we said. I hope you all have an incredible time at university in the autumn. Finally, to our guide Mjellma, without whom we would never have had such a wonderful week.

EGMO began in 2012 as a sort of stepping-stone to help encourage more girls into international Olympiads. Since then it has grown into a contest with its own spirit, atmosphere, and direction. From here, its future looks incredibly bright. It's a joy that I am so very proud to be part of. As I come to the end of my PhD and look to the future, the positive impact EGMO had on me as a girl, and has had on me as a young woman, is blindingly obvious. I hope all of this year's girls look back on this EGMO with the same joy.