

Laidlaw Programme Reflective Report

This summer, I completed a research project on inverse problems and participated in the International Mathematics Competition for University Students in Bulgaria. Reflecting on my academic journey into the study of inverse problems, I have come to realise that the research process is much more than just solving complex mathematical equations. It is an experience that challenges you intellectually and personally, offering numerous opportunities for growth, collaboration, and discovery. Through my exploration of inverse problems, I've delved into fascinating real-world applications while simultaneously developing key skills like independence, time management, and teamwork.

This report offers a detailed reflection on my research experience, including the significance of the work I have been doing, the impact it has had on me, and how I've disseminated my research through discussions and competitions. I will also explore how conducting this research has shaped my future academic and career plans, while highlighting the skills I've gained along the way.

Understanding Inverse Problems

In mathematics, inverse problems involve determining the unknown causes from known effects. While this might sound abstract, these problems are central to many real-world applications, especially in fields where direct observation of a system is impossible. For instance, medical imaging techniques such as CT scans and MRI use inverse problems to reconstruct internal images of the body from external measurements. Similarly, seismologists use inverse problems to model the Earth's interior based on seismic wave data.

Before diving into this research, I had little knowledge of the broad applicability of inverse problems. I had primarily seen mathematics as an abstract discipline, but the practical implications of this research quickly became clear. Studying inverse problems opened my eyes to how mathematics can be used to solve real-world issues, from improving medical diagnostics to exploring the Earth's subsurface.

The Impact and Importance of My Research

The research I've undertaken on inverse problems is impactful because of its interdisciplinary nature and the potential to make a meaningful difference in various fields. One of the most important aspects of inverse problems is their ability to provide insights in situations where direct data is difficult or impossible to collect. In medicine, for example, the development of accurate imaging techniques relies heavily on solving inverse problems. Without these mathematical methods, many diagnostic tools that save lives every day would not be possible.

Understanding the broader applications of inverse problems has made me appreciate the importance of mathematical research in real-world contexts. This has given me a newfound sense of purpose in my academic work, as I now see how the theories I study can translate into technologies and methodologies that have a tangible impact on society.

Disseminating My Research and Attending the International Mathematics Competition

One of the most exciting aspects of my research experience has been the opportunity to share my work with other mathematicians. I was fortunate to attend the International Mathematics Competition for University Students in Bulgaria, where I had the chance to discuss my research with other mathematics students from around the world. This was a truly unique experience, both professionally and personally, that greatly contributed to my academic growth.

At the competition, I was able to discuss my research on inverse problems with students and faculty from various countries. The opportunity to engage with others who shared my passion for mathematics was incredibly rewarding. We exchanged ideas, shared our respective challenges, and learned from one another's experiences. I was inspired by the range of research being conducted by my peers, which broadened my perspective on the field of mathematics.

Moreover, attending an international event exposed me to different cultures and ways of thinking. I met students from countries I had never visited before, and the cultural exchange was just as enriching as the academic discussions. Exploring a new country, navigating unfamiliar customs, and bonding with people from diverse backgrounds gave me a deeper appreciation of the global nature of academic collaboration. It also sparked my curiosity about the world, as I realised how much there is to learn from those whose experiences differ from mine.

Overcoming Challenges and Personal Growth

While attending the competition was an incredible experience, it also posed challenges. Competing against students with more experience or advanced knowledge of certain topics initially made me feel intimidated. However, I soon realised that this environment was not just about competition—it was about learning and growth. Once I overcame my initial feelings of shyness and self-doubt, I was able to fully engage with the competition and the people around me.

This experience taught me a lot about perseverance and the importance of stepping outside my comfort zone. I challenged myself by working on difficult maths problems alongside students who had much more experience than I did. Rather than being discouraged, I saw this as an opportunity to learn from others and push myself to new heights. This shift in perspective was key to making the most of the experience. By the end of the competition, I had made friends with people I never would have met otherwise, and I left feeling more confident in my abilities.

Presenting Research and Engaging in Discussions

In addition to competing, I also took part in discussions about the research I had been conducting on inverse problems. Being able to explain my work to others, including those unfamiliar with the topic, was an invaluable experience. It required me to communicate complex ideas clearly and concisely, ensuring that my audience could follow along even if they were not specialists in the field.

The feedback I received from my peers and faculty members helped me refine my understanding of inverse problems and challenged me to think about my research from new angles. In particular, some discussions made me realise the importance of interdisciplinary collaboration, as inverse problems often span fields like physics, engineering, and biology. These interactions helped me see how my research could be applied beyond the boundaries of pure mathematics.

Academic and Professional Growth

Conducting research into inverse problems has had a profound impact on my academic trajectory. It has not only deepened my understanding of mathematics but also introduced me to valuable research techniques that I will carry with me throughout my career. From learning how to formulate research questions to developing solutions to complex mathematical problems, I have gained critical skills that will serve me in my future academic endeavours.

One of the most rewarding aspects of this research experience has been the opportunity to develop my independent research skills. Unlike coursework, where problems are typically well-defined with clear solutions, research requires a different approach. I had to learn how to navigate ambiguity, explore multiple methods, and evaluate different solutions. This independence has given me confidence in my ability to tackle challenging problems, which will be invaluable as I continue my academic journey.

Furthermore, I've gained practical skills in time management and project organisation. Balancing research with coursework and other responsibilities required careful planning and discipline. These time-management skills will be crucial as I move forward in my studies, especially if I take on larger research projects or pursue graduate studies.

Personal Growth and Cultural Exposure

Beyond the academic skills I developed, the experience of attending the International Mathematics Competition had a significant impact on me personally. Travelling to a new country and meeting people from diverse backgrounds broadened my horizons in ways I had not anticipated. I gained a deeper appreciation for the importance of cultural exchange, realising how much there is to learn from others outside my immediate circle.

The friendships I made during the competition have also had a lasting effect on me. These are people I will stay connected with for years to come, and I know that we will continue to support each other in our academic pursuits. The experience reinforced the idea that collaboration and mutual support are key to success, both in academics and in life.

Leadership Skills Gained

Throughout this research period, I've developed important leadership skills that I did not initially expect to gain. The independence required in conducting research taught me how to take initiative and manage my projects without relying too heavily on external guidance. This self-sufficiency has been a critical lesson in leadership, as it has shown me the value of taking ownership of my work and decisions.

Additionally, balancing various tasks (such as preparing for the competition, producing research posters, and attending conferences) has significantly improved my time-management and organisational skills. I have learned how to prioritise tasks effectively and manage multiple deadlines, all of which are essential leadership traits. These skills will serve me well as I continue to take on more challenging projects in the future.

Future Career and Research Plans

As I look ahead to the next phase of my academic journey, I plan to continue exploring the field of inverse problems and their applications. I'm excited to participate in future competitions, such as the Imperial-Cambridge Mathematics Competition, where I can build on the skills I've developed and challenge myself further.

While I am still uncertain about my long-term career plans, I am confident that the skills I've gained through this research will open many doors for me. Whether I choose to pursue a career in academia, industry, or a different field, the problem-solving, research, and leadership skills I've acquired will be invaluable. I also look forward to continuing my education, potentially pursuing graduate studies in applied mathematics, where I can further explore the real-world applications of inverse problems.

Conclusion

Reflecting on my research into inverse problems and the experiences I've had along the way, I am incredibly grateful for the opportunities this journey has provided. The process has not only deepened my understanding of mathematics but has also taught me valuable lessons about independence, leadership, and cultural exchange. Participating in international competitions, sharing my work with others, and collaborating with mathematicians from around the world have all contributed to my academic and personal growth.

As I move forward, I am excited to continue exploring the fascinating world of inverse problems and look forward to the opportunities that await me. The skills I have gained during this research period will undoubtedly shape my future, and I am eager to see where they will lead.

Scholar Report

Name:	Claire Zhang Hannick
Faculty:	School of Mathematics
Email address:	Clairezhanghannick@gmail.com
Title of Scholarship Project:	Inverse Problems and International Competition

Supervisor

Please comment on your scholar's research period, what you consider to be your scholars' strengths and which leadership attributes you feel your scholar has demonstrated and is particularly skilled in. You could also identify areas which your scholar can develop further.

Claire has demonstrated independence and leadership throughout the research period, through her dedication to her research on inverse problems, as well as her willingness to compete internationally representing the University of Leeds. Within our meetings, I noticed Claire's attention to detail and perseverance when attempting maths problems.

Signature of Scholar __Claire Hannick__ Date: _25/09/2024

Signature of Project Leader



Date: 25/09/2024