Jakub Pickering

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Summary

Mathematics undergraduate at Durham University specialising in pure mathematics, with broad interests in geometry, topology and algebra. My current work includes a summer project on the curve-shortening flow supervised by Professor Raphael Zentner and I am working on a third year project which explores the Poincaré Conjecture, supervised by Professor Andrew Lobb. I have also been mentored by Professor Yang-Hui He in his capacity as fellow of The London Institute of Mathematical Sciences and have participated in seminars on algebraic geometry. I aim to pursue research in pure mathematics with a focus on geometric and topological structures.

Education

Durham University Sep 2023 – Jun 2026

Bachelor of Science in Mathematics (expected First Class Honours)

- **First Year:** Average **80%**, including **94%** in Calculus I, **85%** in Probability I, and **81%** in Linear Algebra I. Established a strong analytical foundation and developed early interests in topology and analysis.
- **Second Year:** Average **82%**, including **92%** in Analysis in Many Variables II, **88%** in Complex Analysis II and **80%** in Algebra II; ranked 15th out of 120 students in my cohort.
- **Third Year (*current*):** Specialising in pure mathematics, taking modules in Analysis III, Geometric Topology, Galois Theory, and Differential Geometry. Completing a dissertation on the Poincaré Conjecture under the supervision of Professor Andrew Lobb, and serving as an undergraduate marker for Level 2 Mathematics modules.

These studies have deepened my interest in geometry, topology, and algebra, and have motivated me to pursue postgraduate research, particularly in algebraic topology and algebraic geometry.

Richard Hale School 2016 – 2023

A Levels: **Mathematics (A*)**, **Further Mathematics (A*)**, **Physics (A)**.

- Awarded the **Senior Mathematics Prize** (2022, 2023) and the **Senior Physics Prize** (2021) for outstanding academic performance.
- Founded and led the **Richard Hale Mathematics Society**, organising weekly problem-solving sessions to mentor younger students and foster mathematical interest.

Research and Projects

Applications of Analytic Continuation to PDEs, Topology, and Theoretical Physics Aug 2025

Co-authored with a fellow student and friend

Investigated analytic continuation as a unifying framework across complex analysis, topology, and theoretical physics. The paper examined holomorphic extensions, the analytic continuation of the Riemann zeta function, and Wick rotations, highlighting the role of Riemann surfaces and the Monodromy Theorem in relating analytic and geometric structures.

Curve Shortening Flow and the Maximum Principle: Avoidance and Convexity Sep 2025

Supervised by Professor Raphael Zentner

Studied the curve shortening flow as a model geometric evolution equation, analysing how parabolic PDE methods - particularly the maximum and comparison principles govern the flow's geometric behaviour. Explored proofs of the avoidance and convexity theorems, the role of infinite propagation and smoothing, and connections to Grayson's theorem, linking analysis and geometry in the study of evolving curves.

London Institute for Mathematical Sciences (LIMS) Mentorship 2022 – Present

Mentored by Professor Yang-Hui He

Invited to the London Institute for Mathematical Sciences by Professor Yang-Hui He, participating regularly in seminars, colloquia, and the LONTI series. Collaborated with researchers and discussed current topics at the interface of geometry, topology, and mathematical physics, as well as emerging links between geometry, artificial intelligence, and machine learning. Gained first-hand experience of a mathematical research environment and was mentored by Professor He, whose seminar series *A Playful Introduction to Some Modern Geometry* profoundly influenced my understanding of modern geometry.

Quantitative Analysis: Bitcoin and Portfolio Efficiency Sep 2025

Independent study examining Bitcoin's impact on portfolio volatility and diversification. Analysed five years of BTC, S&P 500, and Gold data to compute returns, volatilities, and correlations. Constructed efficient frontiers with/without BTC exposure, incorporating rebalancing and transaction costs. Simulated BTC price shocks to assess stability and optimise risk-adjusted returns. Built a Streamlit dashboard for real-time frontier and sensitivity analysis.

Year 3 Project: The Poincaré Conjecture and 3-Manifolds 2025 – 2026

Supervised by Professor Andrew Lobb, Durham University

Ongoing dissertation in low-dimensional topology exploring the structure of 3-manifolds through the lens of the Poincaré Conjecture. I have worked under the supervision of Professor Andrew Lobb, whose guidance has deeply influenced my geometric intuition. The project studies Dehn surgery, Heegaard splittings, and related constructions in the classification of 3-dimensional spaces. I am currently analysing the paper *Eight Faces of the Poincaré Homology Sphere* (Kirby and Scharlemann) to understand techniques used in constructing and distinguishing 3-manifolds.

Independent Study and Reading Ongoing

I am pursuing independent study in topology, geometry, analysis, and probability beyond the undergraduate syllabus. My recent reading includes Grimmett's Percolation, Reid's Undergraduate Algebraic Geometry, and Rudin's Principles of Mathematical Analysis. This self-directed work complements my undergraduate dissertation and reflects a long-standing interest in independent mathematical exploration.

Teaching and Academic Experience

Private Mathematics Tutor and Co-Founder, Independent Tutoring Programme 2019 – Present

Co-founded a tutoring company offering support across STEM subjects. I deliver advanced mathematics tuition for A-Level and undergraduate students. Design and teach courses preparing candidates for the MAT and STEP examinations, with emphasis on proof-based reasoning, problem-solving, and conceptual understanding. Several students have subsequently received offers from Oxford and Cambridge.

Undergraduate Marker, Durham University 2025 – Present

Mark assignments for second-year mathematics modules, ensuring accuracy and consistency in grading under faculty supervision.

Zero Gravity Mathematics Mentor 2024 – Present

Mentor for widening-participation students applying for mathematics at leading UK universities, offering academic guidance and interview preparation.

Extracurricular Activities and Interests

Organiser of Jane Street-style problem-solving sessions in Durham's Quant Fund; previously contributed as a mathematics specialist for Data Annotation - training AI models at solving admissions test style problems. Music Director of University College Function Band; member of Durham University Cricket Club. Interests include fitness, history, travel, and music.