Ruey-An Shiu

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Education

National Taiwan University — **Taipei, Taiwan**
B.S. in Mathematics, B.A. in Economics (Honor), GPA: 4.10/4.30 — *Sep. 2021 – (Expected) Jun. 2026*
- Minor in Computer Science

University of California San Diego — **California, USA**
University of California Education Abroad Program, GPA: 4.00/4.00 (Provost Honors) — *Fall 2024*

2025 SLMath Summer Graduate School — **California, USA**
Statistical Optimal Transport — *Jun. 9^{th} – Jun. 20^{th}, 2025*

Publication

Ruey-An Shiu and Hsuan-Wei Lee. "Shaping network structures in evolutionary games for stronger cooperation." *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 481(2322), 20250346 (2025).

Ruey-An Shiu and Chun-Hsiung Hsia. "On the Synchronization of ReLU Version of Dense Networks." *Chaos, Solitons and Fractals: the Interdisciplinary Journal of Nonlinear Science, and Nonequilibrium and Complex Phenomena,* Volume 202, Part 1, 117444 (2026).

Tony Feng, Trieu Trinh, Garrett Bingham, Jiwon Kang, Shengtong Zhang, Sang-hyun Kim, Kevin Barreto, Carl Schildkraut, Junehyuk Jung, Jaehyeon Seo, Carlo Pagano, Yuri Chervonyi, Dawsen Hwang, Kaiying Hou, Sergei Gukov, Cheng-Chiang Tsai, Hyunwoo Choi, Youngbeom Jin, Wei-Yuan Li, Hao-An Wu, **Ruey-An Shiu**, Yu-Sheng Shih, Quoc V. Le, Thang Luong. "Semi-Autonomous Mathematics Discovery with Gemini: A Case Study on the Erdős Problems." *arXiv:2601.22401*.

Conference

Ruey-An Shiu and Parinaz Naghizadeh. "Opinion Dynamics in Multi-Layer Social Networks: Consensus and Convergence in Coordination Games." *The 61^{st} Annual Allerton Conference on Communication, Control and Computing (Allerton'25)*, (2025).

Daniel Wei-Chung Miao, Xenos Chang-Shuo Lin, **Ruey-An Shiu**. "Exact Analytical Option Pricing Formula Under a Jump-Diffusion Model with Hawkes Intensity." *Association of Asia-Pacific Operational Research Societies (APORS) Youth Forum*, (2025).

Research Experience

2026 Globalink Research Internship, University of Waterloo — Expected (Summer 2026)
- *Advisor:* Prof. Roberto Guglielmi
- **Topic:** Mathematical modelling and control of wildfire.

Research Assistant, Department of Economics, NTU — Sep. 2025 – Present
- *Advisor:* Prof. Hung-Jen Wang
- Developed an extended stochastic frontier model that integrates flexible distributional assumptions with cross-validation-based model averaging (JCVMA), explicitly accounting for model uncertainty and heterogeneous production technologies across agricultural units.
- Evaluated computational efficiency across multiple numerical integration techniques to optimize the estimation procedure for large-scale empirical applications.
- Applied the framework to ICRISAT panel data for Indian rice farmers to quantify technical efficiency and analyze productivity determinants.

Research Assistant, College of Health, Lehigh University (Remote) — Aug. 2024 – Present

- *Advisor:* Prof. Hsuan-Wei "Wayne" Lee
- Designed a general network rewiring framework comparing random, preference-based, degree-targeted, and hybrid partner-switching rules in repeated social dilemmas.
- Analytically characterized parameter regions where cooperation persists in dynamically evolving networks despite defection incentives.
- Analyzed epidemic spreading dynamics on hypergraph structures, extending classical SIS models to incorporate higher-order interactions where infections occur through simultaneous contact with multiple agents.

Research Assistant, Financial Engineering Research Lab, NTUST Aug. 2023 – Present

- *Advisor:* Prof. Daniel Wei-Chung Miao
- Extended the classical jump-diffusion model by letting jump intensity follow a Hawkes process, derived exact analytical jump-count distributions and a recursive European option pricing formula, and used it to show how Hawkes parameters drive clustered jumps, option prices, and implied volatilities.
- Proposed a shifted-gamma jump-diffusion (SGJD) model with left-skewed jump sizes, derived analytical formulas for VaR and ES, and demonstrated that the skewness parameter η has a strong impact on tail risk, especially over short horizons and at high confidence levels.
- Extended the classical jump-diffusion option pricing framework to allow serially correlated jump sizes modeled by an autoregressive process, obtained analytical European option prices and hedging parameters, and showed through numerical and calibration studies how jump-size autocorrelation affects returns, option values, hedging performance, and implied volatility smiles.

2025 Student Summer Research Fellowship Program, University of Chicago Summer 2025

- *Advisors:* Prof. Haifeng Xu, Prof. Jibang Wu
- Formulated a generalized principal–agent model in which agents follow approximate best responses instead of perfect rationality and recast nonlinear incentive compatibility constraints as linear inequality systems that partition the contract space into regions with internally consistent behavioral patterns.
- Proved that the rank of the social welfare operator acts as a key complexity parameter in robust mechanism design, characterizing when optimal contracts with boundedly rational agents can be computed in polynomial time and when the problem becomes NP-hard.

Independent Study, UCSD (Remote) Jan. 2025 – Sep. 2025

- *Advisor:* Prof. Morris Ang
- Conducted independent reading in random conformal geometry with a focus on Schramm–Loewner Evolution as a scaling limit of discrete lattice models, learning how conformal invariance of random curves provides a rigorous framework for critical phenomena in two-dimensional statistical physics.
- Studied foundational papers and textbooks on the connection between SLE and conformal field theory, focusing on martingale observables and conformal maps to understand how they encode probabilities of curve events and characterize SLE as a canonical conformally invariant measure on random interfaces.

Member of the Multi-agent Intelligence and Decision Systems Lab, UCSD Fall 2024

- *Advisor:* Prof. Parinaz Naghizadeh
- Formulated a multiplex coordination game in which agents alternate between online and offline social network layers with distinct topologies, capturing how behavior co-evolves across overlapping interaction channels.
- Established that primitivity of the product transition matrix guarantees consensus and identified conditions under which cross-layer coupling stabilizes or destabilizes coordination relative to isolated single-layer dynamics.
- Derived exponential convergence rates for opinion dynamics over periodic switching cycles using spectral analysis and random-walk techniques, quantifying how quickly disagreements decay.
- Proved that when one layer dominates the switching schedule, the consensus outcome converges to that layer's equilibrium and remains robust to small structural perturbations.

2024 Undergraduate Research Project Scholarship, NSTC Jul. 2024 – Feb. 2025

- *Advisor:* Prof. Daniel Wei-Chung Miao
- Extended the Double Exponential Jump Diffusion model by introducing time-varying jump intensity and volatility parameters that adapt across market regimes. Enabled the process to capture transitions between crisis and calm periods while preserving analytical tractability for empirical calibration.
- Developed a HypoErlang-based option pricing framework by deriving closed-form analytical expressions for the probability density and moment-generating functions of log returns. Obtained explicit European option valuation formulas that capture heavy tails and jump clustering without numerical integration.

2023 NCTS Undergraduate Research Program, NCTS Oct. 2023 – Jun. 2024

- *Advisor:* Prof. Chun-Hsiung Hsia
- Motivated by strongly competitive biological systems, analyzed ReLU-modified Kuramoto oscillators on dense networks with competitive coupling where standard Lyapunov methods fail.
- Designed a specialized ansatz-based proof technique that establishes sufficient conditions for ynchronization under asymmetric interactions.
- Demonstrated that ReLU-modified Kuramoto systems achieve synchronization under weaker coupling conditions than classical smooth models, but exhibit slower convergence rates.

2023 Undergraduate Summer Research Program, NCTS Summer 2023

- *Advisors:* Prof. Gi-Ren Liu, Prof. Yuan-Chung Sheu
- Applied Stein's method to derive quantitative convergence rates for sums of weakly dependent random variables, obtaining explicit error bounds for normal approximations in Wasserstein and Kolmogorov distances.
- Extended the Stein-equation approach to non-Gaussian target distributions including stable and variance-gamma laws, providing approximation theory for heavy-tailed systems where classical Gaussian limits are inadequate.

Awards

2025: International Federation of Operational Research Societies (IFORS) Travelling Fellowship

2025: NSTC College Student Research Creativity Award

2025: National Taiwan University Bachelor's Thesis Award

2025: Shih Kung-Sing Outstanding Thesis Award

2025: National Taiwan University Overseas Internship Scholarship

2024: Taiwan Mathematical Society Outstanding Students Prize

2024: Chow Hung-Ching Scholarship

Fall 2023, Spring 2024, Spring 2025: Academic Achievement Award (Top 5%)

2023: Finance and Mathematics Joint Scholarship

2023: National Taiwan University Voyage of Aspirations Scholarship for Exchange Students

2019: Asian Pacific Mathematics Olympiad (APMO) Bronze Award

Teaching Experience

Fall 2023, Fall 2024, Fall 2025 : Teaching Assistant, Stochastic Processes (FIN7050)

Fall 2023: Teaching Assistant, Introduction to Ordinary Differential Equations (MATH2217)

Spring 2024: Teaching Assistant, Introduction to Partial Differential Equations (MATH2218)

Computational Skills / Other

Programming: R, Python, C++, MATLAB, Julia

Languages: Mandarin (native), English (fluent)

Last updated: February 5, 2026