HAMZA VIRK

hvirk2@pride.hofstra.edu | Website | Google Scholar | Github

Education

Hofstra University Sept. 2022 – May 2026
Bachelor of Science in Mathematics (Major GPA: 3.7) *Hempstead, NY*
Presidential Scholarship • Dean's List 2024–2025

Publications

Blind-IGT: Jointly Decoding Rewards and Rationality in Entropy-Regularized Games

- Authors: **H Virk**, S Amaglobeli, Z Syed
- Under review at *Double-Blind Conference* [arXiv]

Arbitrage-Free Pricing with Diffusion-Dependent Jumps

- Authors: **H Virk**, Y Wu, M John
- Under review at *Journal of Stochastic Analysis* [SSRN]

Entry Deterrence and Antibiotic Conservation under Post-Entry Bertrand Competition

- Authors: R Mazzoleni, **H Virk**
- Under Review at *Economics Letters* [Draft]

On the Properties of Second Order Linear Recurrences with Rational Coefficients

- Authors [†]: M Lippmann, E Rowland, **H Virk**
- Preparing submission to *Journal of Integer Sequences* [Draft]

Improving a Propensity Score Adjustment Method in Genetic Association Studies using Machine Learning

- Authors: V Berardi, **H Virk**, J Ferbinteanu, M John
- Working paper

[†] *Authors listed alphabetically (pure mathematics convention)*

Experience

Student Researcher, EconCS Group May 2025 – October 2025
Hofstra University *Hempstead, NY*

Academic Area: Algorithmic Game Theory, Machine Learning Theory

Collaborators: Sandro Amaglobeli, Zuhayr Syed

- Pioneered the Blind-IGT framework to resolve fundamental multiplicative scale ambiguity in bilinear inverse problems, enabling first joint recovery of reward parameters and rationality in Quantal Response Equilibria.
- Developed NLS estimator and rigorously proved it achieved the optimal convergence rate; extended the framework to Markov Games proving optimal rates and robustness to unknown transition dynamics.

Research Assistant, Department of Mathematics November 2024 – Present
Hofstra University *Hempstead, NY*

Academic Area: Mathematical Finance, Stochastic Processes

Advisor: Dr. Yihren Wu

- Established a rigorous framework for arbitrage-free pricing in models with path-dependent jumps. Solved the complex measure-change problem using Girsanov's theorem and conditional Esscher transforms.
- Implemented a Gaussian HMM on SPX and VIX data to study market dynamics, using the Lee–Myland test to detect and categorize jumps, analyzing how these jump types affected subsequent state transitions.

Student Researcher, Department of Economics September 2025 – Present
Hofstra University *Hempstead, NY*

Academic Area: Industrial Organization, Health Economics
Advisor: Dr. Roberto Mazzoleni

- Developed a game-theoretic Industrial Organization model (SPNE) to analyze how Bertrand competition impacted antibiotic conservation by incumbents facing market entry in the presence of evolving resistance.
- Proved that the anticipation of fierce price competition universally incentivized strategic conservation to deter entry, independent of bacterial cross-resistance levels—a sharp contrast to established Cournot models.

Research Assistant, Department of Mathematics January 2025 – Present
Hofstra University *Hempstead, NY*

Academic Area: Number Theory, Combinatorics
Advisor: Dr. Eric Rowland

- Characterized integer occurrences in linear recurrences, proving restrictions on consecutive terms and establishing finiteness results via p-adic logarithmic bounds.
- Ran computational experiments for 24+ weeks testing millions of coefficient pairs to identify minimal/maximal integer runs under certain conditions, using patterns from data to recursively construct new integers.

Research Intern, Feinstein Institute for Medical Research June 2025 – Present
Northwell Health *Manhasset, NY*

Academic Area: Biostatistics, Genetic Epidemiology
Advisor: Dr. Majnu John

- Implemented machine learning methods for confounder detection and subset selection in high-dimensional genetic data, improving statistical power of a recently published propensity score-based method.
- Compared the performance of various approaches using extensive simulations in R, and a real data analysis of a genome-wide association study.

ASPiRe REU Fellow May 2025 – August 2025
Hofstra University *Hempstead, NY*

Academic Area: Topological Machine Learning, NLP Robustness

Project: Topological Data Analysis for hallucination detection in LLMs

- Applied persistent homology to LLM attention, developing a framework to detect hallucinations by comparing a response's internal persistence diagram to its prompt-grounded one, measuring the divergence via the Wasserstein distance.

Talks and Presentations

PerToDive for Provable Hallucination Detection August 2025

- ASPiRe Symposium, Hofstra University

Integer Sequences Satisfying a Linear Recurrence December 2025

- Mathematics Department Seminar, Hofstra University

Relevant Coursework

- MATH 171/172: Real Analysis I & II[T]
- MATH 173: Complex Analysis
- MATH 167: Elementary Topology[T]
- MATH 137: Probability & Statistics
- ECON 186: Econometrics
- MATH 145: Abstract Algebra
- MATH 071/072/073: Calculus I, II, III
- MATH 114: Intro to Higher Mathematics
- MATH 135A: Linear Algebra
- MATH 199B: Statistical Inference[G]
- ECON 172: Game Theory
- MATH 198A: Matrix Algebra & Comp.[G]
- MATH 143: Engineering Mathematics
- ECON 132: Intermediate Macroeconomics
- MATH 216: Nonlinear Optimization[G]
- MATH 199C: Topological Data Analysis[G]

T = Taking Spring 2026
G = Cross-listed/Grad Course

Technical Skills

Languages: Python, Stata, R, LaTeX
Libraries/Packages: NumPy, pandas, Matplotlib, scikit-learn, hmmlearn; ggplot2, dplyr, tidyr, caret (R), estout, outreg2
Specialized Techniques: Maximum Likelihood Estimation, Hidden Markov Models, Time Series Analysis, ARIMA Modeling, Monte Carlo Simulation, Bootstrap Resampling, Model Calibration

Honors and Awards

Presidential Scholarship, Hofstra University 2022 – 2026
Merit-based near full-tuition scholarship awarded to top incoming students for academic excellence.

ASPiRe Research Fellowship, ($5000 Award) 2025
Competitive research fellowship supporting undergraduate research awarded to a dozen or so students every year.

Dean's List 2024 – 2025

Academic Excellence Scholarship, Forman Christian College, Lahore 2021 – 2022
Merit-based scholarship awarded for outstanding academic performance in Viva and Board Level examinations.

Top 5% in Punjab Board (BISE) Examinations 2020 & 2021
Ranked among top 5% of students in provincial standardized examinations across Punjab, Pakistan.

Graduated 3rd in class of 94, Beaconhouse School System, Lahore 2020
Graduated with distinction, ranking third among 94 students in highly competitive high school cohort.

Languages and Interests

Languages: English, Urdu (Native), Punjabi
Interests: Chess, Literature, Music