HAMZA VIRK

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EDUCATION

Hofstra University Hempstead, NY
B.S. in Mathematics Sept 2022 – May 2026
Major GPA: 3.7 • Presidential Scholarship • Dean's List 2024–2025

PAPERS

Blind-IGT: Jointly Decoding Rewards and Rationality in Entropy-Regularized Competitive Games
H Virk, S Amaglobeli, Z Syed
Under review, *AISTATS 2026* §

Arbitrage-Free Pricing with Diffusion-Dependent Jumps
H Virk, Y Wu, M John
Under review, *Journal of Stochastic Analysis* §

Entry Deterrence and Antibiotic Conservation under Post-Entry Bertrand Competition
R Mazzoleni, **H Virk**
Working paper

Improving a Propensity Score Adjustment Method in Genetic Association Studies using Machine Learning
V Berardi, **H Virk**, J Ferbinteanu, M John
Working paper

Integer Occurrences in Rational Linear Recurrences
M Lippmann, E Rowland, **H Virk**[†]
Working paper
[†] *Authors listed alphabetically (pure mathematics convention)*

RESEARCH

Student Researcher, EconCS Hofstra University
Collaborators: Sandro Amaglobeli, Zuhayr Syed May 2025 – October 2025

- 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 Hofstra University
Advisor: Dr. Yihren Wu November 2024 – Present

- 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.

Research Intern, Feinstein Institute for Medical Research Manhasset, New York
Advisor: Dr. Majnu John June 2025 – Present

- Developed 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.

Research Assistant, Department of Economics Hofstra University

Advisor: Dr. Roberto Mazzoleni September 2025 – Present

- 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 Hofstra University

Advisor: Dr. Eric Rowland January 2025 – Present

- 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.
- Characterized integer occurrences in linear recurrences, proving restrictions on consecutive terms and establishing finiteness results via p-adic logarithmic bounds.

ASPiRe REU Fellow Hofstra University

Project: Topological Data Analysis for hallucination detection in LLMs May 2025 – August 2025

- 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*, ASPiRe Symposium, Hofstra University August 2025
- *Near-Integer Sequences Satisfying a Linear Recurrence*, Mathematics Department Seminar December 2025

RELEVANT COURSEWORK

- MATH 171/172: Real Analysis I & II[T]
- MATH 173: Complex Analysis
- MATH 135A: Linear Algebra
- MATH 143: Engineering Mathematics
- MATH 199C: Topological Data Analysis
- MATH 145: Abstract Algebra
- MATH 199B: Statistical Inference
- MATH 216: Nonlinear Optimization
- MATH 137: Probability & Statistics
- MATH 167: Elementary Topology[T]
- MATH 198A: Matrix Algebra & Comp.
- ECON 186: Econometrics
- ECON 172: Game Theory
- ECON 132: Intermediate Macroeconomics
- MATH 114: Intro to Higher Mathematics
- MATH 071/072/073: Calculus I, II, III
- CSC 14: Discrete Mathematics
- MATH 100: Communicating Mathematics

T = Taking Spring 2026

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 • ASPiRe Summer Research Fellowship ($5000 award) • Dean's List 2024–2025 • Academic Excellence Scholarship, Forman Christian College

LANGUAGES AND INTERESTS

Languages: English, Urdu (Native), Punjabi

Interests: Chess, poker, literature, music