Junhao (Kris) Zhang

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Education

University of Waterloo *Sept. 2022 – Dec. 2025*

Bachelor of Mathematics, Mathematics and Business Administration Double Major, Statistics Minor

Relevant Coursework: Forecasting, Deterministic OR Models, Advanced Optimization, Biostatistics, Survey Sampling, Linear Modeling, Data Structures, Corporate Finance.

Technical Skills

Python, R, SAS, MATLAB, SQL, Gurobi, Haskell, Lean 4, Excel, Bloomberg Terminal

Research Experiences

Climate-Informed Mortality Modeling for Insurance and Financial Risk *Waterloo, ON*

Directed Research/Reading Program *May 2025 – Aug. 2025*

Mentor: Rhoda Dadzie-Dennis (University of Waterloo PhD Candidate)

- Studied whether **long-term temperature trends improve mortality forecasting**, with applications in life insurance pricing and pension liabilities under climate change.
- Implemented and extended the **Lee–Carter mortality model** using Ontario population data (1991–2023), incorporating mean annual temperature as a climate covariate.
- Conducted **out-of-sample forecast evaluation** in **R** and **Python**, comparing baseline and climate-adjusted models using RMSE, MAPE, and residual diagnostics.
- Co-authored an editor-reviewed article, *"The Financial System in a Warming World"*, published in ***Notes from the Margin***, Canadian Mathematical Society, Vol. XIX (2025).

Formal Theorem Proving in Applied Mathematics Using Lean 4 *Waterloo, ON*

Directed Research/Reading Program *Sept. 2025 – Dec. 2025*

Mentor: Sita Gakkhar (University of Waterloo Postdoctoral Fellows)

- Explored the use of **Lean 4** as a formal system for expressing and proving results in **applied mathematics**, focusing on the formalization of optimization theory.
- Studied and applied core techniques for theorem proving in Lean 4, including dependent type theory, propositions and proofs, quantifiers and equality, inductive types, type classes, and **tactic-based proof construction**.
- Developed Lean 4 representations of the mathematical structures underlying linear programming, including finite-dimensional vectors, dot products, and primal–dual feasibility conditions.
- Constructed a **mechanically verified proof of the Weak Duality Theorem** for linear programming in **Lean 4**, formalizing feasibility assumptions and inequality reasoning within a rigorously checked proof framework.

Projects

Schedule Optimization for GO Transit Networks *Waterloo, ON*

Applied Optimization Project *Sept. 2025 – Dec. 2025*

- Formulated a **mixed-integer programming (MIP) model** to improve GO Transit transfer schedules by minimizing passenger waiting time, incorporating capacity limits and minimum transfer-time constraints to ensure practical feasibility.
- Processed GO Transit schedule data and built **filtering and feasibility models in Gurobi**, estimating transfer demand, vehicle capacities, and allowable schedule adjustments to restrict the optimization to implementable solutions.
- Solved the final MIP in Gurobi, showing that modest schedule adjustments can **reduce total peak-period passenger waiting time by over 50%**, yielding meaningful reliability improvements for daily commuters without adding infrastructure.

Multiple Linear Regression Report for S&P 500 Price Dynamics *Waterloo, ON*

Applied Statistics Project *Sept. 2024 – Dec. 2024*

- Analyzed **linear associations** between the S&P 500 index price and financial, sectoral, and macroeconomic variables using monthly data (1994–2023) sourced from the Bloomberg Terminal.
- Built and compared **multiple linear regression models in R Studio**, addressing **multicollinearity**, interaction effects, and model assumptions through correlation analysis, variance inflation diagnostics, and residual checks.
- Selected a best-performing model using adjusted R^2, AIC, BIC, and PRESS statistics, documenting **limitations** due to time dependence and non-stationarity in financial data.