# Wenxiao Yang | Resume for PhD Application

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## Education

**University of Illinois at Urbana-Champaign**
*Bachelor of Science* *2020–2023 (expected)*

- Triple-Major: *Mathematics, Statistics, Economics*; Minor: *Computational Science & Engineering*
- GPA – 3.97/4.00; Dean's list for all semesters; Phi Beta Kappa
- *Spring 2021: Visiting Research Student at HKUST Business School (Advisor: Song Lin)*

**Zhejiang University**
*Undergraduate Coursework, Experimental Class of Social Science (Economics)* *2018–2020*

- *Spring 2020: GEM Trailblazer Exchange Student at Nanyang Technological University*

## Research Projects

### Writing Sample

**Information Acquisition and Design in Privacy-Preserving Advertising Auctions**
***Solo-authored working paper**, submitted as my **writing sample**; (Theory)* *Ongoing*

- Supervised by Prof. *Yunchuan (Frank) Liu* (UIUC) and Prof. *Song Lin* (HKUST)
- Presented at *ISMS Marketing Science Conference 2022*
- **Keywords:** *Privacy, Game Theory, Rational Inattention, Bayesian Persuasion*
- **Abstract:** I study how an online platform should design a privacy-preserving information environment for advertising auctions. Due to privacy protection, with imprecise data, advertisers need to acquire information prior to bidding for an ad slot. At the same time, the platform needs to pool multiple advertisers together through keywords. By designing the keywords for an advertising slot, the platform can release common information, building on which advertisers can decide how to obtain additional information at a cost. I illustrate that the information acquisition of an advertiser can lead to divergent beliefs, which may lower the bidding cost of the other advertiser. Thus, asymmetric equilibrium may arise where one advertiser engages in information acquisition whereas the other does not. I show that both advertisers will participate in an auction only when the ad slot has an intermediate matching probability. In an optimal information design, the platform maximizes the advertisers' belief about the ad slot while motivating them to bid for it. Furthermore, the platform has the incentive to raise advertisers' cost of information acquisition when the ad slot's prior matching probability is low and to reduce it when the prior matching probability is high. I discuss the implications for privacy-preserving ad auction design and first-party data collection.

### Other Projects:

**Predicting Long-run Coupons Effects with Customer Learning** (Preliminary)
*An attempt to combine analytical modeling with deep learning; (Theory + Data)* *Ongoing*

- **Keywords:** *Machine Learning, Hidden Markov Model, Particle Filter, Deep Learning*
- **Abstract:** This research project aims to improve our understanding of the long-term effects of coupons on brand consumption by incorporating the customer learning effect. Our model will use an analytical model to model how customers learn product information and make purchase decisions dynamically, followed by statistical inference and particle filter techniques to infer customer knowledge of each brand. This customer knowledge will then be incorporated into our deep learning model to predict the impact of coupons on customer behavior and learning over time. By considering the long-term effects of coupons, our model will provide more accurate predictions of coupons' impact on brand consumption.

**NFT Royalty Structure Design and Regulation** (Preliminary)
*with Prof. Song Lin and Zijun (June) Shi (HKUST); (Theory + Data)* *Ongoing*

- **Keywords:** *Non-fungible token, Game Theory, Dynamic Programming*
- **Abstract:** We are currently working on a preliminary project on the NFT (Non-fungible token) royalty structure. Unlike traditional art creators, NFT creators receive a commission from each transaction. We have built a game-theoretic model with one creator and several potential customers, who may be collectors who value the NFT or speculators who buy the NFT in order to resell it. Our study aims to analyze how creators can alter the royalty structure of NFTs to regulate the process of reselling NFTs under various platform rules and the effects of these rules on the royalty structure of NFT creators. To validate our findings, we have used data from various NFT platforms.

**Uncertainty Motivates Honesty: Karma Effect and Externality** (Preliminary, pre-experiment finished)
*with Xuhang Fan (Duke); (Theory + Experiment)* *Ongoing*

- **Keywords:** *Behavioral Economics, Decision Theory*
- **Abstract:** This project is a study of the relationship between uncertainty and honesty in the context of moral decision-making. Our experiment found that offering a lottery as an incentive after a moral decision can have opposite effects on ethical behavior, depending on the moral cost of the decision. When the moral cost is high, the lottery serves as a motivator and encourages ethical behavior, but when the moral cost is low, it can serve as a disincentive and discourage ethical behavior. To explain this phenomenon, we have developed a decision theory model. Xuhang, at Zhejiang University, conducted the initial experimental phase of the project, while I focused on constructing the decision theory model.

**Should Firms Pay for Useless Referrals?**

*Project in algorithmic game theory PhD seminar; (Theory)* *2021 Spring*

- **Abstract:** This paper proposes a new consumer referral program, the "same return program". It rewards users according to the number of friends they refer, regardless of whether it generates new customers. We prove that when the product is hard for consumers to infer others' valuations towards it, the same return program is better than traditional referral programs because it eliminates the game in referral programs and maintains the best equilibrium for firms and consumers.

**A New Promotional Program: Combining Coupons and Referrals**

*Project completed during the semester I visited HKUST; (Theory)* *2021*

- Supervised by Prof. *Song Lin* (HKUST)
- **Abstract:** I propose a new promotional program that combines coupons and referrals. Customers can help the company by referring their friends in exchange for coupons for products. I compare this program with discounts. If the profit on the product is low, the program is more profitable than offering a discount because free referrals are preferable to the profit generated by selling the product. Suppose the profit from the sale of the product is relatively high, and the consumer's estimate of the value of the product is very high. In that case, the company will use this option in order to profit from free referrals from satisfied customers. When the profits from the product's sale are relatively high, and the product's value to the consumer is moderate, the company will use discounts to avoid the loss of customers as a result of using the new referral program.

## Research Assistant

**Illinois Risk Lab, Department of Mathematics, UIUC**

*Research Associate* *2020 Fall*

- Topic: Financial Mathematics, Stochastic Optimization
- Research associate in the program of *AI-Powered Life-cycle Financial Planning* lead by Prof. *Zhiyu (Frank) Quan* and Prof. *Runhuan Feng*.
- This project aims to build algorithms that optimize the decision-making process for meeting important financial goals in life. I played a pivotal role in the group that worked on developing a life cycle strategy in asset management.
- 1. Built a Stochastic Linear Programming model independently to optimize the expected utility under uncertainties (factors including death rate, the interest rate of risk asset.) with heterogeneous goals. 2. Assist in implementing the model by utilizing Python.

# Core Coursework

**Social Science, Economics, and Business**

- Intermediate Microeconomics and Macroeconomics
- Intro to Psychology, Brain and Mind, Finance, Accounting, and Management
- Game Theory; Industrial Organization; Public Economics; International Economics
- Applied Econometrics; Numerical Methods in Economics; Statistical Economic Analysis
- *Microeconomic Theory I* *(Microeconomics Sequence; PhD level)*
- *Math Models in Marketing* *(Marketing Modeling; PhD level)*
- *Computational Modeling of Cognition* *(Cognition Science; PhD level)*

**Math, Statistics, and OR**

- Calculus I, II; Linear Algebra; Probability Theory and Mathematical Statistics
- Real Analysis
- Complex Function and Integral Transforms
- Ordinary Differential Equation
- Abstract Linear Algebra
- Abstract Algebra I
- Stochastic Processes
- Mathematical Statistics
- Applied Regression and Design (Statistics)
- Sampling and Categorical Data (Statistics)
- Linear Programming (Math)
- Nonlinear Programming (Math)
- Optimization (Engineering)
- *Pricing and Revenue Management* *(Operations Research; PhD level)*
- *Game Theory and Fair Division* *(Algorithmic Game Theory; PhD level)*

**Computation and Engineering**

- Numerical Methods
- Statistical Learning
- Deep Learning
- Data Science Programming Methods
- Computational Math(computations on graphs, computational topology, quantum computing, etc.)
- *Computational Inference and Learning* *(Machine Learning and Statistical Inference; PhD level)*