

# Zhuoran Zhang

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## Education

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### Carnegie Mellon University

Pittsburgh, PA

Doctor of Philosophy (Ph.D.) in Civil Engineering

May 2022 (Expected)

- GPA: 3.67/4.00
- Dr. Elio D'Appolonia Graduate Fellowship

### Tsinghua University

Beijing, China

Bachelor of Engineering in Construction Management (major)

July 2017

- Thesis topic: *Quantifying scarcity of urban land in China based on multi-dimensional remote sensing data*
- GPA: 3.73/4.00 *Magna Cum Laude*

Bachelor of Science in Psychology (minor)

July 2017

- Thesis topic: *The influence of social comparison on happiness: an individual tracking study based on the experience sampling method*

## Skills

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**Programming Languages:** *Advanced* - Python, SQL, R, Stata; *Intermediate* - SAS, C++, JavaScript

**Software & Packages:** *Advanced* – MATLAB, ArcGIS, QGIS, Pandas, Scikit-learn, Tetrad, DoWhy, EconML, Git; *Intermediate* -PyTorch, GAMS, AWS, GCP

**Languages:** *Fluent* - English, *Native* - Chinese

## Ph.D. Research Projects

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### Mitigating Work Zone Crashes by Causal Inference with High-resolution Data

June 2018 - Present

- Developed map-matching and data-fusion algorithms to manage high-resolution TB-level multi-source data sets, including work zones, accidents, traffic speed, and weather at minute and meter level (Publication [3])
- Proposed a novel causal inference model based on Regression Discontinuity Design to infer safety effects of work zone deployment configurations, eliminating confounding bias (Publication [1,2])
- Proposed a causal forest model with lagged-dependent variable to infer the heterogeneous treatment effect of work zone presence on crash risk with unmeasured confounders
- Developed a causal model with Rubin's generalized methods (g methods) to infer the treatment effect of work zone presence on crash risk under different posted speed limits
- Authored a technical report submitted to University Transportation Center Program in the U.S. Department of Transportation (Technical Report [1], \$127,500 grant)

### A Holistic Framework for Prioritizing Investments in Bridge Lifting

Aug. 2017 - May 2019

- Led a team of three Ph.D. students and one Post-doc from two Departments, to develop a prioritization framework minimizing construction costs while maximizing social equity
- Implemented a Multi-class Dynamic Traffic Assignment model based on C++ to predict traffic volume changes after bridge lifting projects in a resolution of seconds and meters
- Authored a technical report submitted to Pennsylvania Infrastructure Technology Alliance (Technical Report [2], \$140,821 grant)

## Professional Experience

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### Overstock.com, Inc.

Salt Lake City, UT

Machine Learning Data Science Intern -- Experimentation Science

June - Aug. 2021

- Proposed a power analysis model for difference-in-difference online web test
- Proposed to leverage past experiments as instruments to infer the heterogeneous treatment effect of business levers on gross merchandise sales

### Department of Civil and Environmental Engineering, Carnegie Mellon University

Pittsburgh, PA

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### Relevant Graduate Course Projects

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#### Inferring Causal Effects of Weather Conditions on Work Zone Crash Risk

Aug. - Dec. 2020

On course: Causality and Machine Learning

- Performed a Fast Causal Inference model and LiNGAM using Tetrad and R to evaluate the causal effects of weather conditions on work zone crash risk (Achieved a grade of 100/100)

#### A Real-world Audio Adversary against Wake-word Detection Systems

Jan. - May 2019

On course: Probabilistic Graphical Model

- Collaborated with two Ph.D. students to perform a time-delayed bottleneck highway network with Discrete Fourier Transform using PyTorch to mimic the wake word detection on Amazon Alexa Voice Assistant
- Investigated the usage of a projected gradient descent model for adversarial audio attacks against the "Alexa" wake word detection on Amazon Alexa Voice Assistant

#### Predicting Building Energy Demand Using Building Automation System Information

Aug. - Dec. 2017

On course: Data-driven Building Energy Management

- Implemented and compared five models (OLS, subset based on regression score, LASSO, Ridge, partial least square) to predict building energy demand using building time-series information.

#### A Web-based Bridge Management System

Aug. -Dec. 2017

On Course: Advanced Python and Web Prototyping

- Scrapped web contents of a state bridge management system (legally permitted) with billions of entries and GB level text contexts, using Selenium
- Designed and administrated a multiple-user web server permitting users to query, edit, and visualize bridge data on online maps, with Django and MySQL

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### Relevant Graduate Coursework

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80816 Causality and Machine Learning, 10701 Machine Learning (Ph.D. level), 10718 Data Analysis & Machine Learning for Public Policy, 10725 Convex Optimization, 94834 & 94835 Applied Econometrics, 10718 Probabilistic Graphical Models, 12752 Data-driven Building Energy Management, 94867 Decision Analytics and Business Policy, 12780 Advanced Python and Web Prototyping for Infrastructure Systems

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### Publications

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- [1] **Zhuoran. Zhang**, Sean Qian, and Burcu Akinci. (2021). Inferring Causal Effects of Work Zone Deployment Configurations on Crashes. Working paper for *Transportation Research Part B: Methodological*
- [2] **Zhuoran. Zhang**, Sean Qian, and Burcu Akinci. (2021). Inferring Causal Effects of Work Zone Configurations on Crash Risk. Submitted to *The Transportation Research Board (TRB) 101<sup>st</sup> Annual Meeting*
- [3] **Zhuoran Zhang**, Burcu Akinci, and Sean Qian. (2021). A Novel Map-matching Algorithm for Relating Work Zones and Crashes. Accepted in *Construction Research Congress 2022*
- [4] **Zhuoran Zhang**, Burcu Akinci, and Sean Qian. (2021). Identifying Temporal Instability in Factors Causing Work Zone Crash Occurrences Using Fast Causal Inference. Accepted in *ASCE International Conference on Computing in Civil Engineering 2021*
- [5] **Zhuoran Zhang**, Maoshan Qiang, and Hanchen Jiang. (2017). Finding Academic Concerns on Real Estate of U.S. and China: A Topic Modeling Based Exploration. In *Proceedings of the 21st International Symposium on Advancement of Construction Management and Real Estate*. (pp. 807-817). Springer, Singapore.

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### Technical Reports

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- [1] **Zhuoran Zhang**, Sean Qian, and Burcu Akinci. (2018). Inferring causal effects of crashes in work zones: A case study in Pennsylvania. To *U.S. Department of Transportation, University Transportation Center Program*.
- [2] **Zhuoran Zhang**, Samuel Jones, Crystal Fernandez-Pena, Jooho Kim, Sean Qian, Burcu Akinci, Daniel Armanios. (2019) A Holistic Framework for Prioritizing Investments in Bridge Lifting. To *Pennsylvania Infrastructure Technology Alliance (PITA)*.