

# ZAIRA PAGAN CAJIGAS

Ph.D. Candidate · Industrial and Operations Engineering · University of Michigan

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*Last updated in October 2024*

## PROFESSIONAL PROFILE

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An **applied engineer** specializing in applications-driven research utilizing operations research tools, including advanced modeling, simulation, data analytics, machine learning, and statistical analysis, to assess risks, infrastructure vulnerabilities, and disaster resilience. Experienced in collaborative multi-disciplinary team environments, including industry, government, and non-profit sectors.

## EDUCATION

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<b>Ph.D., Industrial and Operations Engineering</b> <i>University of Michigan, Ann Arbor, MI</i> Advisor: Seth Guikema, Ph.D.	2020 - Present
<b>M.S.E., Industrial and Operations Engineering</b> <i>University of Michigan, Ann Arbor, MI</i>	2020 – 2022
<b>B.S., Industrial Engineering</b> <i>University of Puerto Rico, Mayaguez, PR</i> Academic Honor: Magna Cum Laude Departmental Honor: Frederick W. Taylor Award	2014 – 2020
<b>Faculty of Economics and Business</b> <i>Universidad Complutense de Madrid, Madrid, Spain</i>	2018

## RESEARCH INTEREST

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**Methodologies:** simulation, simulation – optimization, data analytics, machine learning, predictive modeling, statistics, and spatial analysis

**Applications:** community resilience, disaster risk assessments, emergency management, critical services and infrastructure, climate change, power outages, risk analysis

**Programming Tools:** R, Python, MATLAB, Simio, EPANET, ArcGIS

## RESEARCH EXPERIENCE

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<b>Enhancing Community Resilience: Assessing Post-Disaster Access to Essential Services through Community-Driven Evaluation</b> <i>Anticipated journal submission February 2025</i> <ul style="list-style-type: none"><li>• <b>Developed an interconnected water, power, and communication network</b> to evaluate how tropical cyclones impact the resilience of these critical infrastructures.</li><li>• Developed a framework that analyzed <b>access to operational essential services at the building level</b> pre- and post-hazard and <b>identified areas with limited-service access</b> to facilitate equitable resource distribution and targeted resilience-building efforts.</li></ul>	2024-Present
<b>Estimating Tropical Cyclone-induced Power Outages in Future Climate Scenarios</b> In collaboration with Industrial Economics Inc. <i>Anticipated journal submission October 2024</i>	2023 – 2024

- **Developed and implemented a power outage prediction model** to assess the impacts of projected tropical cyclones on power outages along the East and Gulf Coast regions, utilizing data from seven global climate models.
- **Estimated potential changes in power outage frequency** under future climate scenarios, providing insights into regional vulnerabilities under climate-related risks.
- Evaluated the impact of tropical cyclone-induced **power outages across different socio-demographic groups**.

#### **Water outage predictions for natural hazards using synthetic water distribution systems.**

2021 – 2023

In collaboration with One Concern, Inc.

*Submitted to Risk Analysis July 2023 – 2<sup>nd</sup> round of review*

- Developed Python algorithm that **generates synthetic water distribution systems** from publicly available data, capable of producing pressure-feasible system for existing communities across the United States.
- Implemented simulation techniques to **forecast building-level water outages**, integrating the synthetic system data, along with hazard impact information, and component fragility analyses.

#### **Are Existing Frameworks Effective in Identifying and Prioritizing Critical Services and their Supporting Infrastructures at a Local Level? A Comparative Study.**

2021 – 2023

In collaboration with the University of Stavanger

*Submitted to Risk Analysis October 2023 – 2<sup>nd</sup> round of review*

- Developed evaluation criteria for frameworks dedicated to identifying critical services and infrastructures, enabling analysis across frameworks varying in geographical scale and focus of evaluation.
- **Identified existing frameworks strengths and limitations** and assess whether these frameworks align with the needs and preferences of the communities.

#### **Equitable Assess to Essential Services: A community-level assessment of essential services in the Caribbean.**

2020 – 2021

- **Led a community-level survey** in the Caribbean region to assess the perception of essential services amongst different socio-demographic groups, highlighting the importance of integrating community insights into emergency management decisions.
- Applied logistic regression techniques to **evaluate how demographic and socio-economic factors**, such as age, family composition, and income, **influence essential services restoration** preferences.

#### **Illicit Massage Business: Laws and Regulations in South-East Michigan**

2019

In collaboration with University of Michigan Law School

- Applied machine learning techniques to **identify which legal measures are most effective in preventing illicit massage businesses** in the state of Michigan, utilizing scraped web data, census information, and local laws and regulations.

## TEACHING EXPERIENCE

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University of Michigan, Ann Arbor, Michigan

*Instructor: IOE 202, Operations Research & Analytics*

Jan 2024 – Apr 2024

- Delivered 14 lectures on Operations Research to over 80 undergraduate students, achieving a 3.6/4 in student assessments.
- Designed the course curriculum, integrating lectures, hands-on exercises, homework assignments, and exams to enhance student learning outcomes.
- Facilitated interactive discussions and exercises to reinforce theoretical concepts and analytical techniques.

*Graduate Student Instructor: IOE 543, Scheduling*

Sep 2022 – Dec 2022

- Developed quizzes and assignments, and graded assignments, quizzes, and exams.
- Facilitated small group discussion sessions during class and held weekly office hours, providing support and mentorship in one-on-one and small-group settings.

*Graduate Student Instructor: IOE 561, Risk Analysis*

Jan 2022 – Apr 2022

- Delivered 2 lectures on Infrastructure Risk Analysis to a hybrid audience of over 100 graduate students.
- Developed quizzes and assignment, and graded assignments, quizzes, and exams.
- Facilitated small group discussion sessions during class and held weekly office hours, providing support and mentorship in one-on-one and small-group settings.

## SELECTED AWARDS AND GRANTS

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### Graduate Honors and Awards

Bill Anderson Fellow	2024
Society of Hispanic Engineers Doctoral Scholar	2023-2024
SRA Engineering & Infrastructure Student Merit Honorable Mention	2022
University of Michigan Student Academic Multicultural Initiative (SAMI) Award	2022
Bonder Travel Scholarship Award	2022
Risk Analysis Specialty Group (FRASG) Student Merit Award winner	2021
University of Michigan Rackham Merit Fellow	2020-2025

### Undergraduate Honors and Awards

University of Puerto Rico Frederick W. Taylor Award	2021
Institute of Industrials Engineers CIAPR Juan A. Torres Gorbea Award	2021
University of Puerto Rico Mayaguez Honor Scholarship	2018-2020
University of Puerto Rico Mayaguez Honor Roll Student	2016-2020

## PUBLICATIONS

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Peterson D, Carter K, Wald D, Gustafson W, Hartz S, Donahue J, Eilers J, Hamilton A, Hutchings K, Macchiavelli F, Mehner A, **Pagan Cajigas Z**, Pfeiffer O, Van Middendorp A, *Carbon or cash: Evaluating the effectiveness of environmental and economic messages on attitudes about wind energy in the United States*, Energy Research & Social Science, Volume 51,2019, Pages 119-128, ISSN 2214-6296

**Pagan-Cajigas, Z. P.**, Guikema, S., Otaduy-Ramirez, R., Woolley, V., Smith, K., Hu, T., Chen, T. (July 2023). *Water outage predictions for natural hazards using synthetic water distribution systems*. Manuscript submitted for publication in Risk Analysis Journal on July 2023. \*

**Pagan-Cajigas, Z. P.**, Guikema, S., Flage, R. Are Existing Frameworks Effective in Identifying and Prioritizing Critical Services and Infrastructures at a Local Level? A Comparative Study. Manuscript submitted for publication in Risk Analysis Journal on October 2023. \*

\* Manuscripts are currently on 2<sup>nd</sup> round of reviews

## WORKING PAPERS

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**Pagan-Cajigas, Z. P.**, Guikema, S., *Enhancing Community Resilience: Assessing Post-Disaster Access to Essential Services through Community-Driven Evaluation.*

Guikema, S., **Pagan-Cajigas, Z. P.**, Fant, C., Boehlert, B., *Estimating Tropical Cyclone induced Power Outages Impact in Future Climate Scenarios for the Gulf and East Coast of the US.*

**Pagan-Cajigas, Z. P.**, Guikema, S., Fant, C., Boehlert, B., *Estimating Tropical Cyclone induced Power Outages in Future Climate Scenarios' Impact on Socio-economically Vulnerable Populations and Racial Minorities.*

**Pagan-Cajigas, Z. P.**, Guikema, S., White, A., Carr, B., *Laws and Regulations Against Illicit Massage Business: A Data-Driven Analysis of Regulatory Impacts in South-East Michigan.*

## CONFERENCE PRESENTATIONS

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**Pagan-Cajigas, Z. P.**, Guikema, S., "Estimating Tropical Cyclone induced Power Outages in Future Climate Scenarios' Impact on Socio-economically Vulnerable Populations and Racial Minorities", 2023 Society of Risk Analysis Annual Meeting, Washington, District of Columbia Dec 2023

**Pagan-Cajigas, Z. P.**, Guikema, S., Fant, C., Boehlert, B., "Estimating Tropical Cyclone induced Power Outages in Future Climate Scenarios.", 2023 INFORMS Annual Meeting, Phoenix, Arizona Oct 2023

**Pagan-Cajigas, Z. P.**, Guikema, S., Fant, C., Boehlert, B., "Estimating Tropical Cyclone induced Power Outages in Future Climate Scenarios.", 2023 European Safety and Reliability Conference, Southampton, United Kingdom Sep 2023

**Pagan-Cajigas, Z. P.**, Guikema, S., "Water outage predictions for natural hazards using synthetic water distribution systems.", 2022 Society of Risk Analysis Annual Meeting, Tampa, Florida Dec 2022

Guikema, S., **Pagan-Cajigas, Z. P.**, "Measuring Equity in Access to Services.", 2022 INFORMS Annual Meeting, Indianapolis, Indiana, Oct 2022 Oct 2022

**Pagan-Cajigas, Z. P.**, Guikema, S., "Equitable Access to Essential Services: A community-level assessment of essential services in the Caribbean.", 2022 IISE Annual Conference & Expo, Seattle, Washington May 2022

**Pagan-Cajigas, Z. P.**, Guikema, S., Flage, R., "A Framework Comparison for Community Level Risk Assessments", Risk Analysis Specialty Group (FRASG) Student Merit Award winner, 2021 Society of Risk Analysis Annual Meeting, Virtual Dec 2021

## INDUSTRY EXPERIENCE

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**One Concern Inc.**, Menlo Park, CA 2022  
*Data Analyst*

- Enhanced the synthetic water distribution model by generalizing its layout and hydraulic functions to process larger spatial-scale networks, including integrating multiple water treatment plants.
- Proposed network reduction techniques (e.g., skeletonization, cauterization, hierarchical intersection continuity negotiation) to improve the algorithm's processing time efficiency in larger-scale networks.

**Techno Plastics Industry**, Añasco, PR 2019- 2020  
*Manufacturing Engineer*

- Designed a manufacturing line with the capacity to meet a monthly demand of 15,000 units.
- Developed standardized operating procedures for two new product lines, ensuring quality and regulatory compliance.

- Performed the equipment's capacity analysis to determine the number of employees for each operation.

**Edwards Lifesciences, Añasco, PR**

2018

*Manufacturing Engineer Intern*

- Increased the Clips and Clamps manufacturing line's efficiency by 32%.
- Reduced workforce by 33% through the design of a new line balance with an estimated cost reduction of \$55,442 per year.

**Bearing Buddies, Patillas, PR**

2018

*Layout Design Intern*

- Analyzed current Bearing Buddy Inc. packing station and identified nonvalue-added tasks.
- Designed an efficient packing station subject to the workflow pattern. Designed a new layout that reduced the manufacturing line space by 20%.

**Medtronic, Villalba, PR**

2016- 2017

*Operational Excellence Intern*

- Transformed 3 traditional manufacturing lines into 3 Cell Operating Systems.
- Provided High Maturity Support to 5 Manufacturing Cells by implementing Lean Continuous Improvement methodology.
- Reduced the manufacturing line space by 35%, reduced workforce by 20%, and improved quality

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#### **PROFESSIONAL OUTREACH AND MENTORSHIP DURING Ph.D. PROGRAM**

**Teaching:** *Instructor:* IOE 202,  
*GSI:* IOE 543, IOE 561

**Reviewer:** Reviewer of 5 papers for the SRA Journal

**Mentor:** Service Learning for Transdisciplinary Education (2 middle school students),  
Guikema Lab (3 undergraduate students),  
INFORMS Michigan Student Chapter (4 master students, 1 PhD student),  
IOE Graduate Application Mentoring Program (4 undergraduate students, 2 master student)

**Volunteer:** Food Gathers, Xplore Engineering Summer Camp, Discover Engineering Summer Camp, Kids Who Code, DACEP

**Leadership:** Society of Risk Analysis Engineering and Infrastructure Specialty Group Secretary and Treasurer,  
UMICH Industrial and Operations Engineering DEI student representative,  
INFORMS at UM Antiracism, Diversity, Equity, and Inclusion Chair,  
Society of Hispanic Engineers (SHPE) at UM Outreach Chair

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#### **OUTREACH PROGRAMS DURING UNDERGRADUATE PROGRAM**

**Volunteer:** **Come Colegial:** Orchestrated 6 fundraising events to provide food for low-income students at the University of Puerto Rico

**Puerto Rico Humanitarian Relief Post Hurricane Maria:** Organized food distribution logistics for the central municipalities of Puerto Rico during the recovery period following the impact of Hurricane Maria.

**Siempre Vivas:** Group facilitator for women that had suffered from abuse.

**Leadership:** Alpha Pi Mu Honor Society Outreach Chair,  
American Society for Quality Student Chapter Treasurer