

Karim Naguib

Economist/Data Scientist | Bayesian Methods & Causal Inference
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Summary

Economist/data scientist with 9+ years of experience in **causal inference**, **experiment design**, and **statistical modeling**. Currently applying advanced Bayesian methods in oncology drug development at AstraZeneca. Expert in building **hierarchical state-space models**, **survival analysis**, and **clinical trial analytics** using R, Stan, and Julia. Experienced in using **Bayesian networks** for causal identification in experimental and non-experimental contexts. Proficient in **reinforcement learning** for partially observable environments. Focused on rigorous quantification of uncertainty for decision-making.

Skills

Programming: R, Tidyverse, Stan, Julia, Flux.jl, Turing.jl, C/C++, Ruby, Python, SQL

Statistical Methods: Hierarchical modeling, Gaussian processes, state-space models, survival analysis, experimental design, instrumental variables, difference-in-differences, regression discontinuity, deep reinforcement learning, particle filters, Monte Carlo methods, Bayesian neural networks

Tools: RStudio, VS Code, AWS EC2/S3/ECR, Azure, Docker, Cluster Computing (SLURM), Databricks, Git and Github, Snowflake, PostgreSQL, cmdstanr, targets workflow management, Domino, agentic AI (Claude, ChatGPT)

Education

Boston University | Boston, MA | **Ph.D. in Economics** | 2014

Focus: Development economics, health economics, and experimental economics

The American University in Cairo | Cairo, Egypt | **B.S. in Computer Science, Minor: Mathematics** | 1999

Experience

Senior Data Scientist | **AstraZeneca** | Aug 2023 - present

Advanced Bayesian State-Space Modeling for Oncology Clinical Trials

- Developed sophisticated hierarchical Bayesian state-space models for tumor growth dynamics using the Stein-Fojo framework with simultaneous regression and growth components
- Implemented log-transformed state-space formulation with Gaussian process temporal correlations for irregular time intervals
- Built comprehensive Stan models with efficient MCMC sampling across population, trial, and patient levels
- Created scalable computational framework for patient-level state calculations
- Developed RECIST response prediction models for clinical decision support
- Integrated survival analysis with competing risks for progression-free survival and overall survival endpoints

- Implemented real-time forecasting capabilities for censored patients
- Created comprehensive validation framework with leave-future-out cross-validation for temporal model validation

Independent Researcher | Nov 2022 - Aug 2023

Reinforcement Learning for Intervention Optimization

- Designed and built a [Julia package](#) for a reinforcement learning solution (partially observable Markov decision process), using Monte Carlo tree search, to optimize intervention implementation and evaluation decisions
- Used Bayesian hierarchical models to predict future states in POMDP
- Used particle filters for faster online planning
- Project writeup: [The Funder's Meta-Problem](#)
- [Implemented](#) various deep reinforcement learning agents and models using Julia and Flux.jl

Senior Data Scientist | Opendoor | May 2021 - May 2022

- Designed and built continuous randomized experiments to estimate and predict demand and supply elasticity in real estate markets. These were the principal models used in determining offers for home buying/selling
- Used Gaussian processes to construct nonlinear time-series prediction models
- Used hierarchical models to capture heterogeneity in different markets, offer types, etc.
- Designed a survival and time-series model to capture the duration homes are on the market and how this affects elasticity
- Solicited stakeholders to capture prior beliefs about both the structure of models and distributional uncertainty, which is critical in facilitating decision-making in small data environments
- Designed non-experimental causal identification strategies for contexts where experiment manipulation is not possible

Independent Researcher/Consultant | May 2019 - May 2021

- [Built](#) a structural Bayesian model representing a behavior model, using data from a large-scale social experiment conducted in Kenya
- Worked on authoring an economics research paper on findings from the experiment
- [Built](#) a hierarchical model to evaluate the effectiveness of a scaled economic intervention program in Bangladesh
- Used Gaussian processes to model correlation in intervention effects based on spatial proximity
- Designed and built a hierarchical model investigating the heterogeneity of COVID-19 transmission in different countries under different stay-at-home restrictions
- [Used](#) a simulated method of moments approach to fit the AcceleratingHT model's parameters to the CGD model's predictions of vaccine success
- Implemented R [package](#) for bounded identification of counterfactuals, in directed acyclic graphs, in the presence of imperfect compliance with experimental treatment assignment

Economist | Evidence Action | May 2014 - May 2019

- Designed and oversaw the implementation of two large-scale experiments in Kenya and Bangladesh, evaluating interventions aimed at altering health behavior and incentivizing seasonal migration to fight malnutrition, respectively
- Responsible for evaluating any evidence-based decisions by the organization

Software Design Engineer in Test | Microsoft | Apr 1999 - Mar 2007

- Constructed testing framework for the Windows Debugging Tools and command line utilities

Publications

Published

Nathan Barker, C. Austin Davis, Paula López-Peña, Harrison Mitchell, Ahmed Mushfiq Mobarak, Karim Naguib, Maira Reimão, Ashish Shenoy, and Corey Vernot, “Migration and Resilience during a Global Crisis.” *European Economic Review* (Accepted)

Working Papers

Harrison Mitchell, A. Mushfiq Mobarak, Karim Naguib, Maira Reimão, and Ashish Shenoy, “External Validity and Implementation at Scale: Evidence from a Migration Loan Program in Bangladesh.”

Edward Jee, Anne Karing, and Karim Naguib, “Optimal Incentives in the Presence of Social Norms: Experimental Evidence from Kenya.”