ANGIE MOON
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Applicant Information

- **Name:** Angie H. Moon
- **School:** Massachusetts Institute of Technology (MIT)
- **Program:** Ph.D. in Transportation
- **Year of Entry:** September 2023
- **Expected Year of Completion:** TBD (likely 2027)

Area of Interest

- Bayesian entrepreneurship and entrepreneurial decision making

Faculty Member Supplying Letter of Recommendation

- **Scott Stern**, Professor of Management, MIT Sloan School of Management

ANGIE.H MOON

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VISION

Contrarian scholar making Bayesian calibrated choices. I understand how probabilistic inference drives action and apply this to manage operations and innovation.

FEATURED PUBLICATIONS

- **(Textbook) Gelman, A., et al. (2020)** - *Bayesian data analysis* (**Moon, H.** et al. Translator). Translation of foundational Bayesian text.
- Modrak, M., **Moon, AH.**, Kim S., et al. (2022) - Simulation-Based Calibration Checking for Bayesian Computation: The Choice of Test Quantities Shapes Sensitivity, *Bayesian Analysis*.
- (Book) Moon, S., Choi, K., & **Moon, H.** (2022) - *Inventory management using system dynamics, operational optimization research*. Bookcube.
- **Moon, H.**, Song, B., & Lee, H. (2022) - Mixed pooling of seasonality for time series forecasting: Application to pallet transport data. *Expert Systems with Applications*, 201, 117195.
- **Moon, H.**, & Choi, J. (2021) - Hierarchical spline for time series prediction: Application to naval ship engine failure rate. *Applied AI Letters*, 2(1), e22.

EXPERIENCE

Founder & CEO

NextOpt (Analytics Consulting Startup)

Mar. 2017 – Mar. 2022 Seoul, Korea

- Founded NextOpt, focusing on accessible analytics solutions for inventory management and forecasting.
- Secured 85k grant from the National IT Industry Promotion Agency, growing analytics services.

Chair, StanKorea

Stan (Probabilistic Programming Community)

Aug. 2018 – 2021 Seoul, Korea

- Established knowledge sharing ecosystem by translating Bayesian Data Analysis textbook and organizing workshops. Promoted probabilistic programming education in Korea on Youtube platform which has over 1.2k subscribers.

EDUCATION

Ph.D. Candidate in Transportation

MIT

Sep.2023–Present Cambridge, MA

Working with Prof.Charles Fine & Scott Stern on Bayesian entrepreneurship; how entrepreneurs make **bayesian calibrated choices**. GPA: 5.0/5.0

Pre-doc in System Dynamics

MIT Sloan

Aug.2022–Aug.2023 Cambridge, MA

- Research with Prof.Charles Fine & Hazhir Rahmandad on **quality control of model** on its supply chain from algorithm developer to modeler to policy maker to stakeholder.
- TA: Bringing data into dynamic modeling (Prof.Hazhir Rahmandad)

M.S. in Industrial Engineering and Operations Research

Columbia University

Aug.2021–Jul.2022 New York, NY

- Research with Prof.Andrew Gelman & Garud Iyengar on **trust building approximation** using diagnostics for model-based inference.
- TA: Stochastic modeling (Prof.David Yao)

B.S. in Industrial Engineering

Seoul National University

Mar.2015–Jan.2021 Seoul, Korea

GPA: 4.18/4.3; Class Ranking: 1/32

TECHNICAL SKILLS

Probabilistic Programming, Optimization, Bayesian Statistics, Python, R, Business Analytics

HOBBY

Using product sequence (movie, novel, paper), I construct rational meaning and judgment of its creator (director/actor, writer, scholar). I admire ergodic life.

My dissertation investigates how entrepreneurs should choose between different testing approaches when evaluating novel opportunities. This research addresses a fundamental paradox identified by Kenneth Arrow: how can we have a theory of the unexpected? If we could fully understand what novelties will emerge, they would not be novelties. Bayesian entrepreneurship provides a framework for resolving this paradox - while we cannot predict innovations with certainty, we can study how entrepreneurs systematically learn about novel opportunities through testing. Specifically, I examine when entrepreneurs should conduct GMT (simultaneously testing an idea's market potential and execution) versus MVT (testing either market potential or execution independently) versus no testing.

The theoretical foundation rests on exchangeability, which states that the sequence of sampling strategies does not affect our inference about an idea's underlying parameters - this property allows entrepreneurs to separate learning about an idea's inherent quality from learning about specific implementation outcomes. Under this assumption, one can form and update beliefs about an idea's **market potential** (**ϕ**) and **implementation effectiveness** (**θ**) by sampling from their joint distribution. Through Bayesian modeling and simulation, I show that entrepreneurs must decide whether to learn about **ϕ** and **θ** separately (MVT) or jointly (GMT). Three core hypotheses emerge: **H1** says that higher prior mean increases GMT preference ($\partial P(GMT)/\partial \mu > 0$) as the opportunity cost of delayed entry grows. **H2** shows that the effect of prior variance depends on whether entrepreneurs overestimate market potential - when $\mu > \varphi_{true}$, higher variance decreases GMT preference, while when $\mu < \varphi_{true}$, higher variance increases GMT preference. **H3** establishes that sample size effects depend on both prior optimism and testing costs - when μ significantly exceeds φ_{true} and testing costs c_y are low, larger samples increase GMT preference. For instance, Commonwealth Fusion opted to test a 20 Tesla magnet (a GMT approach) rather than building a tokamak with conventional magnets (a MVT validation), because successful magnet performance (**θ**) would simultaneously validate their theoretical pathway to reactor viability (**ϕ**). As CEO Robert Mumgaard explained, "We built this so that the magnet was the really difficult thing to do. And then if you had the magnet, the next step would be much easier," highlighting how the GMT could resolve uncertainty about both parameters at once.

I employ a unified probabilistic programming framework that integrates decision theory with Bayesian learning to analyze these hypotheses. The framework leverages exchangeability to systematically study how market uncertainty, testing costs, and correlation factors influence optimal testing choices through simulation and parameter manipulation. I have developed a simulation environment demonstrating how these factors interact to drive testing decisions, with initial results supporting the hypotheses while revealing nuanced relationships between factors.

Through participation in the Boot Camp, I aim to accomplish three objectives. First, I seek to refine the mathematical representation of these testing choices to better capture real entrepreneurial decision contexts. Second, I plan to develop empirical validation strategies that can test these behavioral predictions in actual entrepreneurial settings. Third, I hope to strengthen the connection between theoretical insights and practical entrepreneurial decision-making. This research ultimately aims to help entrepreneurs make better-informed decisions about testing strategies by understanding the systematic relationships between market conditions and optimal learning approaches, providing actionable guidance for evaluating novel opportunities under uncertainty.