Miguel Raúl Pebes Trujillo

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Contact information

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Research interests

Development of statistical models and inference algorithms for understanding and control of real-world systems. I have worked in a variety of domains including telecommunications, fraud and pattern-change detection, mobility analysis, risk management, hierarchy and network inference, and currently remote sensing and precision agriculture. Technical Core: Bayesian modeling, MCMC methods, machine learning, and the philosophy of inductive reasoning.

Education

Ph.D. in Statistical Science	Ph.D. Minor in Complex Networks & Systems Indiana University Bloomington, USA Co-Advisors: Daniel Manrique-Vallier, Andrew Womack	2023
M.S. in Statistics	Pontifical Catholic University of Peru	2015
B.S. in Computer Science	Pontifical Catholic University of Peru	2008

Academic Positions

- **Research Fellow in AI and Data Science** 2023-2025
  School of Materials Science and Engineering, Nanyang Technological University, Singapore

  Core: Bayesian models for precision agriculture. Singapore imports ∼90% of its food and aims to meet 30% of nutritional needs locally by 2030. My models aim to continuously steer crop trait development (yield, nutritional content and taste) and accelerate growth cycles to make Singapore farming economically sustainable. I have developed Bayesian reinforcement learning models that currently control the daily irrigation of experimental plants in a greenhouse in northwestern Singapore. I am also working on the discovery of new remote sensing indexes to predict crop traits using Bayesian Nonparametrics on hyperspectral data. Funded by the National Research Foundation (NRF), Singapore. Lead PI's: Kee Woei Ng and Matan Gavish. I also co-led the elaboration of a S$2.3 million NRF "Central Gap Fund" grant proposal.

- **Visiting Assistant Professor** 2022-2023
  Department of Statistics, Indiana University Bloomington, USA

Stat-S 520: Introduction to Statistics	FA2022
Stat-S 611: Applied Statistical Computing	SP2023
Stat-S 301: Applied Statistical Methods for Business	SP2023

  My students' majors were varied including M.S. in Data Science, Ph.D. and M.S. in Computer Science, Ph.D. in Information Science, Ph.D. in Economics, and M.A. in International Studies.

- **Teaching Assistant** 2016-2022
  Department of Statistics, Indiana University Bloomington, USA

Stat-S 426/626: Bayesian Theory and Data Analysis	FA2021, FA2020, F2019, S2019
Stat-S 611: Applied Statistical Computing	SP2022, SP2021, SP2020, FA2018, FA2016
Stat-S 431: Applied Linear Models I	FA2021, FA2020
Stat-S 352: Data Modeling and Inference	SP2021
Stat-S 670: Exploratory Data Analysis	SP2018, SP2017
Stat-S 350/520: Introduction to Statistics	SU2020, SU2019
Stat-S 303: Statistics for the Life Sciences	FA2016

- **Research Assistant** 2018-2020
  Department of Statistics, Indiana University Bloomington, USA

  Project "Bayesian approaches to financial auditing". Developed a model prototype to estimate the probability of material misstatement in ledgers from anomaly patterns in audit data. Funded by Deloitte & Touche. PI's: Daniel Manrique-Vallier and Andrew Womack.

Peer Review Service

- **Scientific Committee Member** 2025
  IEEE/GRSS International Geoscience and Remote Sensing Symposium (IGARSS)
  Topic codes: T/D: Data Analysis, T/A: AI and Big Data, CCS.45: Crop Growth Models and RS

- **Journal Reviewer** 2024-2025
  IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing
  Under keywords: Statistics, Intelligent Systems, Artificial Intelligence

Research Papers

1. Harikumar, A.; Shenhar, I.; **Pebes-Trujillo, M.**; Qin, L.; Moshelion, M.; He, J.; Ng, K. W.; Gavish, M.; Herrmann, I. (2024). Leveraging Hyperspectral Features for Biomass Estimation in Chinese Broccoli: Assessing the Physiological Impact of Iron Dosage. IGARSS 2025 — 2025
2. **Pebes-Trujillo, M.**; Shenhar, I.; Harikumar, A.; Herrmann, I.; Moshelion, M.; Ng, K. W.; Gavish, M. (2024). Ranking Learning for Experiment Evaluation — 2024
3. **Pebes-Trujillo, M.**; Shenhar, I.; Harikumar, A.; Herrmann, I.; Moshelion, M.; Ng, K. W.; Gavish, M. (2024). Hierarchical Change-Point Detection (in progress) — 2024
4. Harikumar, A.; Shenhar, I.; **Pebes-Trujillo, M.**; Qin, L.; Moshelion, M.; He, J.; Ng, K. W.; Gavish, M.; Herrmann, I. (2024). Harnessing Smartphone RGB Imagery and LiDAR Point Cloud for Enhanced Leaf Nitrogen and Shoot Biomass Assessment - Chinese Spinach as a Case Study — 2024
5. Harikumar, A.; Shenhar, I.; **Pebes-Trujillo, M.**; Qin, L.; Moshelion, M.; He, J.; Ng, K. W.; Gavish, M.; Herrmann, I. (2024). Smartphone LiDAR Reliably Estimates Leaf Nitrogen Concentration and Shoot Biomass on Leafy Vegetable Crops. IGARSS 2024 — 2024
6. **Pebes-Trujillo, M.**; Manrique-Vallier, D.; Ahn, Y. Y.; Womack, A. J. (2022). Inference of Hidden Hierarchies from Observable Networks (in progress) — 2022
7. **Pebes-Trujillo, M.**; Manrique-Vallier, D. (2022). Burst Detection in Call Trains for Identifying Fraud in Telecommunications (in progress) — 2022

Theses

1. "Inference of Hidden Hierarchies From Observable Networks" [Document] — 2023
   Ph.D. dissertation. Co-advisors: Daniel Manrique-Vallier, Andrew Womack
2. "An Application of Discrete-Time Survival Models to Analyze Student Dropouts at a Private University in Peru" [Document] — 2014
   M.S. thesis. Advisor: Giancarlo Sal y Rosas

Presentations

1. "Bayesian Ranking of Treatments for Static Evaluation and Adaptive Intervention" (Poster confirmed) 2025
   14th International Conference on Bayesian Nonparametrics (BNP 14), ISBA (Jun 21-28)
   Department of Biostatistics, Department of Statistics & Data Science, University of California, LA
2. "Bayesian Methods for Crop Trait Optimization in Precision Agriculture Research" (Poster confirmed) 2025
   Conference of the Bayesian Computation Section of the ISBA (BayesComp 2025) (Jun 16-20)
   Department of Statistics & Data Science, National University of Singapore
3. "Crop Trait Optimization via Precision Agriculture: Bridging Machine Learning and Food Security" 2025
   Global Young Scientists Summit 2025 (GYSS 2025), NRF Singapore (Jan 6-10)
   Stephen Riady Centre, National University of Singapore (NUS)
4. "AI for Business Sustainability" (Invited Speaker) 2024
   Association of Women Entrepreneurs of Peru, Lima, Peru (Oct 17)
5. "Hidden-Hierarchy Reconstruction from Bipartite Networks" (Contributed Speaker) [event] 2021
   A Joint Meeting of the International Network for Social Network Analysis (Sunbelt XLI) and the Network Science Society (NetSci 2021) (Networks 2021) (Jul 6)
6. "Burst Detection in Call Trains for Identifying Fraud in Telecommunications" (Poster) 2019
   Symposium on Data Science & Statistics 2019 (SDSS 2019), ASA & IFNA (May 29 - Jun 1)
   Hyatt Regency Bellevue, Bellevue, WA

Relevant Conference Attendance

1. Global Young Scientists Summit (GYSS) 2025. World meeting of young scientists engaging in direct discussions with twenty Nobel Laureates and Eminent Scientists. Stephen Riady Centre, National University of Singapore (Jan 6-10). Attendance by institutional nomination only. 2025
2. ISBA BNP Networking Meeting 2024 and IMS programme Interpretable Inference via Principled BNP Approaches in Biomedical Research and Beyond 2024
   Institute of Mathematical Sciences (IMS), National University of Singapore
3. AI4Science and Nobel Turing Challenge Initiative Conference. Organizers' affiliations: NRF, NTU, NUS and A*STAR from Singapore; Sony AI, The Systems Biology Institute, and RIKEN, from Japan. 2024

Non-degree graduate training

Ph.D. Visiting Student. Department of Network and Data Science. Central European University 2021

International Program in Data Analysis. Entrepreneurship Development Institute, India 2013

Summer Program in Statistics. University of Sao Paulo and Federal University of Sao Carlos, Brazil 2013

Specialization Program in Predictive Analysis and Data Mining. Knowledge and Systems Peru, Lima 2010

Professional Experience

Before my Ph.D., I spent eight years in Data Science, Analytics, Engineering, and Translation roles at a telecom company, developing data mining and machine learning models on large-scale datasets including phone calls, location data, text messages, and browsing records. These models were applied to strategic planning, CRM, risk management, fraud detection, predictive modeling and automation.

- Positions at Entel Peru S.A. Telecommunications; Lima, Peru 2015-2016

  Risk Management Planning Coordinator

  Provided consulting to upper management by developing predictive models for customer attrition, "loan" defaults, and user segmentation; monitoring credit scoring models' calibration; assessing proposed credit-policy risks; and leading rapid data analyses for decision making on risk and fraud prevention. (Oct 1, 2015 - Jul 1, 2016)

  Senior Process Intelligence Coordinator

  Led a team of computer scientists on projects for the Finance Central Department, focusing on quantitative analysis, data visualization, and unstructured data insights. Automated predictive models, developed KPI dashboards, and managed databases. Key projects included phone call traffic and mobility analysis, user segmentation, debt forecasting, billing complaint prediction, and criminal activity detection. (Jul 1, 2015 - Sep 30, 2015)

- Positions at Nextel del Peru S.A., Telecommunications (subsidiary of NII Holdings Inc.) 2009-2015

Process Intelligence Coordinator	Jun 1, 2014 - Jun 30, 2015
Senior Process Intelligence Analyst	Apr 1, 2011 - May 31, 2014
Financial Process Management Analyst	Jan 1, 2011 - Mar 31, 2011
Junior Financial Processes Management Analyst	May 1, 2009 - Dec 31, 2010
Financial Process Management Intern	May 1, 2008 - Apr 30, 2009

Software consulting

Consultant for the Forest Resource Monitoring Agency (OSINFOR), Peruvian Government 2016-2017
Project: Implementation of a geo-referenced information system for forest supervisions.
For our software, OSINFOR was awarded the Prize for Good Practices in Public Management.

Advanced statistical and computational skills

Bayesian statistics: Hierarchical modeling and computational inference. MCMC algorithms (Gibbs sampling, Metropolis-Hastings, adaptive strategies), diagnostics, model selection, graphical models.

Machine learning: Supervised and unsupervised methods, generalized linear models (GLMs), hidden Markov models (HMMs), mixture models, graph and DAG inference, etc. Bayesian reinforcement learning and Thompson sampling approaches.

Data mining and pattern recognition: Feature selection, outlier detection, change point detection, rule system inference, mining of linear and non-linear implicit relations, etc.

Numerical methods: RNGs, EM and Newton-Raphson algorithms, Monte Carlo optimization, Bootstrap, heuristics (e.g. grid search, random walks, simulated annealing, genetic algorithms).

Classic statistics: Probability and large sample theory, point and interval estimation, hypothesis testing (e.g. ANOVA), multivariate analysis, time series, etc.

Scientific programming: R, C/C++, Python. I also use these tools: Bash, SSH, Tmux, Emacs.

Programming paradigms: Sequential, object-oriented, and dynamic programming, automation and batch processing, memory management and bit-level programming, APIs, AWS data workflows.

Operating Systems: Mac OS, Linux, Windows.

Additional information

Memberships:	International Society for Bayesian Analysis (ISBA), Sections: Bayesian Nonparametrics, Bayesian Computation, Environmental Sciences.
Languages:	English, fluent in all areas. Spanish, native speaker.

Last update: March, 2025. [1]

[1] Available upon request: (1) Degree certificates. (2) Teaching and Research statements. (3) Syllabi of the courses I've taught. (4) References. (5) Honors and Awards in academia and private sector. (6) Transcripts.