

KUSHAGRA GUPTA

M.S. in Statistics, Stanford University

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EDUCATION

- **Master of Science** **Stanford University**
(expected) July 2023
MAJOR: Statistics
- **Bachelor of Science** **Indian Institute of Technology, Kanpur**
April 2021
MAJOR: Mathematics and Computing, MINOR: Machine Learning

PUBLICATIONS

- **Estimating Monte Carlo variance from multiple Markov chains** [arXiv]
July 2020
Kushagra Gupta, Dootika Vats
Under Review: *Journal of Machine Learning Research* (JMLR)
 - Proposed a multivariate replicated batch means (RBM) estimator of the limiting covariance of ergodic averages from parallel Markov chains and demonstrated its superior convergence and finite sample properties.
 - Proved strong consistency and obtained bias and variance of the estimator under weak mixing conditions.
 - Obtained the closed form asymptotic covariance matrix expression for bivariate normal Gibbs sampler.
- **Bayesian equation selection on sparse data for discovery of stochastic dynamical systems** [arXiv]
Kushagra Gupta, Dootika Vats, Snigdhanu Chatterjee Jan 2021
Under Review: *Technometrics*
 - Developed a Bayesian variable selection technique for identification and elicitation of dynamic systems.
 - Proposed computational strategies that are critical in teasing out the important details about the dynamical system and algorithmic innovations to solve for acute parameter interdependence in the absence of rich data.
 - Discussed the sources of unreliability and instability in inferring dynamical systems from observed data.

RESEARCH PROJECTS

- **Bayesian Inference on 3 Parameter Weibull Distribution** [details]
- Prof. Debasis Kundu (IIT Kanpur)
 - Statistically motivated the approximation of the log-concave posterior by a Gamma density based on moment conditions and explained the inconsistency and inefficiency in MLE estimation for certain cases.
 - Dramatically improved efficiency of the supervisor's posterior decomposition based inference algorithm.
- **Interval Regression using Bayesian Inference** [details]
- Prof. Mohammad A. Rahman (IIT Kanpur), Prof. Dootika Vats
 - Explored interval regression paradigms covering quantile regression (QR), meta-heuristic algorithms, information theory, convex analysis, and set arithmetic linear models.
 - Extended Bayesian QR to continuous and partially observed variables by modifying the quantile loss function.

PROGRAMMING PROJECTS

- **Multi-Class Image Segmentation on Extremely Small Datasets** [details]
- Inter IIT Tech Meet, IIT Bombay (Silver Medal)
 - Designed and implemented a U-Net architecture for image segmentation of high quality satellite images by using context-based representations and localized optimization of parameters with high frequency.
 - Developed a 'one vs all' algorithm with 9 U-Nets to improve accuracy on just 25 images.
- **Multi-Agent Reinforcement Learning using Latent Code** [details]
- Dept. of Computer Science and Engineering, IIT Kanpur
 - Created self-play algorithm for multi-agent atari games. Used variational autoencoders to disentangle multiple near optimal policies extracted with the help of latent code.
 - Achieved close to state of the art win probabilities in multi-agent CTF in collaborative and competitive settings.

WORK EXPERIENCE

- **2021 Google Summer of Code Student** [details]
R project for Statistical Computing
 - Systematically identified and cleared efficiency bottlenecks for the **mcmcse** R package, a leading package for estimating Monte Carlo standard errors of MCMC and reliable calculation of effective sample size.
 - Improved critical subroutines, migrated codebase to Rcpp, introduced parallel implementation of functions.
- **Proprietary Trading Strategies** April 2020 - June 2020
Quantitative Researcher, Kivi Capital, Gurgaon
 - Designed trading strategies combining technical indicators from diverse time-frames to capture market trends.
 - Conducted a comprehensive study of candlestick trading patterns for medium frequency trading of futures.
- **Online Recommendation Engine based on Implicit Feedback** [details]
Machine Learning Intern, New York Office, IIT Kanpur
 - Implemented state-of-the-art algorithm for online collaborative filtering based on Fast Matrix Factorization.
 - Implemented Bidirectional LSTM based model for flagging hate-speech on comments with ELMO embedding.

RELEVANT COURSEWORK

STATISTICS Bayesian Inference, MCMC, Machine Learning*, Econometrics*, Probabilistic ML*, Inference*, Statistical Simulations and Data Analysis*, Time Series, Stochastic Processes

MATHEMATICS Advanced Linear Algebra, Several Variable Calculus, Real Analysis*, ODE, PDE

PROGRAMMING Data Structures and Algorithms, Scientific Computing, Fundamentals of Computing

: (A) exceptional performance

TECHNICAL SKILLS

LANGUAGES R, Python, , SQL, C/C++, Matlab, Stan, Golang

FRAMEWORKS Pytorch, Keras, Libtorch, Tensorflow, Scikit-learn

SOFTWARES/LIBRARIES rstan, mcmcse, sgcmc, Scipy, OpenAI gym, Gensim, NLTK

ACHIEVEMENTS AND ACCOLADES

- Undergraduate department rank in **top 5**.
- **Silver medals** in Inter IIT Technical Meet in Machine Learning and Data Science competitions.
- **All India Rank 157** among 1,500,000 in IIT Joint Entrance Examination (JEE) Mains.
- **National top 1%** in NATIONAL STANDARD EXAMINATION IN PHYSICS, level 1 of IPhO.
- **Statewise top 1%** in NATIONAL STANDARD EXAMINATION IN CHEMISTRY, level 1 of IChO.
- **Kishore Vigyan Protsahan Yojana (KVPY)** fellow in 2016 and 2017,
- **National Talent Search Examination (NTSE)** scholar 2015, awarded by Govt. of India.
- **State topper of Mathematics** in IAIS, organized by UNSW Australia.
- **Mentored more than 150 students** for projects on statistics and machine learning.

EXTRACURRICULARS

LEADERSHIP *Coordinator, PROGRAMMING CLUB, IIT Kanpur*
Coordinator, MATHEMATICS AND STATISTICS SOCIETY, IIT Kanpur

POSITIONS *Member, PROBABILISTIC MACHINE LEARNING AND INFERENCE GROUP, Dept. of CSE, IIT Kanpur*
Student Nominee, DEPARTMENT UNDERGRADUATE COMMITTEE, IIT Kanpur

TALKS *MARKOV CHAIN MONTE CARLO, Special Interest Group in Machine Learning, IIT Kanpur [slides]*
MACHINE LEARNING WINTER CAMP, Programming Club, IIT Kanpur [slides]

DEBATING *Honourable Mention in Parliamentary Debate, HINDU COLLEGE*
Chair of the ASIAN PARLIAMENTARY DEBATE, Cultural Festival IIT Kanpur

OTHER *Core group member of JOURNALISM CELL, IIT Kanpur and DEBATING SOCIETY, IIT Kanpur*