

# Curriculum Vitae

## Shounak Chattopadhyay

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### EDUCATION:

**Doctor of Philosophy**, Statistical Science 2018 – 2023 (expected)  
Duke University  
Dissertation Topic: Scalable and structured Bayesian nonparametric modeling  
(Under the supervision of Dr. David Dunson)

**Master of Statistics (M. Stat)** 2016 – 2018  
Indian Statistical Institute, Kolkata, India  
Dissertation Topic: On the time series modelling of Directional Data  
(Under the supervision of Dr. Atanu Biswas)

**Bachelor of Statistics (B. Stat with Honors)** 2013 – 2016  
Indian Statistical Institute, Kolkata, India

### RESEARCH INTERESTS:

Nonparametric Bayesian inference, Scalable Bayesian inference, Shape constrained function estimation, Latent factor models, Environmental health, Drug interaction modeling

### RESEARCH EXPERIENCE:

**Combination Drug Interaction modeling guided by structural covariate information** (2021+)  
*with Han, R., Tansey, W., and Dunson, D. B.*

- Motivated by discovering effective combination drug therapies in the context of high-throughput cancer data.
- Incorporate relevant drug and cell-line covariate information in the model to identify existing associations between cell-lines and drug combinations.
- Focus on developing an interpretable model with proper uncertainty quantification to identify synergistic drug interactions.

**The Blessing of Dimensionality in Bayesian Latent Factor Modeling** (2020+)  
*with Reeves, G. and Dunson, D. B.*

- Motivated by the need for Bayesian inference in latent factor models with growing sample size and dimension.

- Develop an embarrassingly parallel algorithm to obtain a pseudo-Bayesian estimate of the underlying covariance matrix without the need for Markov chain Monte Carlo (MCMC).
- Application in the context of joint species distribution modeling.

### **Synergistic and Antagonistic Interaction Detection**

(2020-2022)

*with Engel, S. M. and Dunson, D. B.*

- Motivated by the need to detect synergistic or antagonistic drug interactions in mixtures of toxic chemicals in an epidemiological setting.
- Developed the Synergistic Antagonistic Interaction Detection (SAID) framework for identifying such interactions by constructing a novel prior distribution to estimate non-negative or non-positive functions.
- Focused on interpretability of the model and improved predictive performance in comparison to existing methods by incorporating such interactions in the model.
- Application to NHANES 2015-16 data on kidney function.

### **Nearest Neighbor Dirichlet Mixtures**

(2018-2020)

*with Chakraborty, A. and Dunson, D. B.*

- Motivated by the need to develop fast and scalable algorithms for multivariate density estimation with accurate uncertainty quantification.
- Proposed a class of Nearest Neighbor Dirichlet Mixtures for embarrassingly parallel density estimation using Bayesian models in local neighborhoods and combining them to produce a global estimate.
- The proposed method showcased robust performance with increasing dimension and efficient computation with increasing sample size.
- Desirable asymptotic properties are derived providing frequentist justification of the method in terms of consistency and uncertainty quantification.

### **On the time series modeling of Directional Data**

(2017-2018)

*with Biswas, A.*

- Motivated by the need to develop interpretable models for analysis of directional data.
- Explored Peggam's operator to propose a conditional distribution of one categorical variable given another categorical variable.
- An induced autoregressive model of order 1 using Wrapped Symmetric distributions and Asymmetric Geometric distributions was studied.

### **Comparison of Horseshoe priors with other shrinkage estimators**

(2017)

*with Bhattacharya, A. and Mallick, B. K.*

- Studied the performance of the Horseshoe (HS) prior in comparison to other well-known shrinkage priors such as the LASSO, MCP and SCAD.
- Investigated performance under model misspecification to assess robustness of methods.
- A modification of the Horseshoe prior to capture weak signals was explored.
- We compared the methods under a three-cluster data generating model where the signals arrive in two categories of strength, instead of the usual spike-and-slab model.

### **Comparison of Difficulty Levels of different examinations**

(2017)

*with Sengupta, D.*

- Compared difficulty levels of two different sorts of questions in a questionnaire.
- Explored Rasch models and proposed a method to compare between the maximum, minimum, and mean difficulty levels of two questionnaires.

**Image Segmentation Using Mixture Models** (2016)  
*with Parui, S.K.*

- Motivated by modeling pixel distribution in images by a discrete mixture model.
- Developed a mixture model of multivariate Laplace distributions as a robust alternative to existing models of pixel distribution densities.
- Application to standard data sets provided improvements over the Gaussian mixture model.

**Analysis of Survey Methodology adopted in Inflation-Expectation Survey of Households** (2016)  
*with Sengupta, D.*

- Analysis of the Inflation-Expectation Survey of Households (IESH) carried out by the Reserve Bank of India (RBI).
- Proposed a variance estimator for current, 3-month ahead and 1-year ahead inflation expectations using bootstrap methods.
- Used precise GPS locations of each investigator to detect anomalies in data collection.

**Data Classification using Logistic Regression in Asymmetric Cost scenario** (2015)  
*with Sarkar, U.K.*

- Motivated by the presence of asymmetric cost functions in classification problems.
- Implemented a logistic regression model with a variable cutoff parameter determined using the magnitudes of the asymmetric misclassification costs.
- Compared with other methods such as neural networks and decision trees.

## TEACHING EXPERIENCE:

- Teaching Assistant, STA 610 (Multilevel and Hierarchical Models), Duke University, Fall 2022.
- Teaching Assistant, STA 325 (Data Mining and Machine Learning), Duke University, Fall 2021.
- Teaching Assistant, STA 532 (Theory of Statistical Inference), Duke University, Spring 2021.
- Teaching Assistant, STA 111 (Probability and Statistical Inference), Duke University, Spring 2020.

## PUBLICATIONS AND PREPRINTS:

- **Chattopadhyay, S.**, Engel, S.M., and Dunson, D. "Inferring Synergistic and Antagonistic Interactions in Mixtures of Exposures." (*submitted, 2022+*) [\[ArXiv\]](#)
- **Chattopadhyay, S.**, Chakraborty, A., and Dunson, D.B. "Nearest Neighbor Dirichlet Mixtures." (*under revision, Journal of Machine Learning Research, 2021+*) [\[ArXiv\]](#)

- Maitre, L., Guimbaud, J.B., Warembourg, C., Güil-Oumrait, N., Petrone, P.M., Chadeau-Hyam, M., Vrijheid, M., Basagaña, X., Gonzalez, J.R., **Exposome Data Challenge Participant Consortium**. “State-of-the-art methods for exposure-health studies: Results from the exposome data challenge event.” (Environment International, 2022) [\[Link\]](#)

## WORKING PAPERS:

- **Chattopadhyay, S.**, Reeves, G., and Dunson, D.B. “The Blessing of Dimensionality in Bayesian Latent Factor Modeling.”
- **Chattopadhyay, S.**, Tansey, W., and Dunson, D.B. “Combination Drug Interaction modeling guided by structural covariate information.”

## AWARDS:

- Recipient of ISBA Poster Award for ‘Synergistic Interaction Modeling’, ISBA 2022.
- Recipient of BNP13 Travel Award, BNP13 2022.
- Recipient of ISBA Travel Award, ISBA 2022.
- Winner of Capital One Data Challenge, Indian Statistical Institute, Kolkata (2017).
- Winner of Capital One Data Challenge, Indian Statistical Institute, Kolkata (2016).
- Awards in form of book grants for outstanding academic performance, Indian Statistical Institute, Kolkata (2016-18).
- Recipient of the **INSPIRE** scholarship from The Department of Science and Technology, India (2013 – 2018).

## CONTRIBUTED TALKS AND POSTERS:

- Nearest Neighbor Dirichlet Mixtures. *Contributed Poster Presentation at Thirteenth International Conference on Bayesian Nonparametrics*, October 2022.
- Drug Combination Modeling with Hierarchically Weighted Mixture Models. *Contributed Poster Presentation at Thirty-Ninth International Conference on Machine Learning*, July 2022.
- Synergistic Interaction Modeling. *Contributed Poster Presentation at World Meeting of the International Society for Bayesian Analysis*, June 2022.
- Synergistic Interaction Detection. *Contributed Session at World Meeting of the International Society for Bayesian Analysis*, June 2021.
- Nearest Neighbor Dirichlet Process. *Contributed Poster Presentation at Joint Statistical Meetings*, August 2020.
- Scalable Bayesian Methods. *PCM Gold Medal Award Presentation at Indian Statistical Institute, Kolkata*, July 2018.

## TECHNICAL SKILLS:

- R package **SAID**: Implementation of Synergistic Antagonistic Interaction Detection. [\[Link\]](#)
- R package **NNDM**: Implementation of Nearest Neighbor Dirichlet Mixtures. [\[Link\]](#)
- Proficient in R, Python, C++, LaTeX, and Microsoft Office.