Aditya Ghosh

Curriculum Vitae

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Education

2020–Present **Masters of Statistics (M.Stat)**, *Indian Statistical Institute (ISI)*, Kolkata, India
– Theoretical Statistics specialization
– Scored **94.4%** in the first year.

2017–2020 **Bachelor of Statistics (B.Stat)**, *Indian Statistical Institute (ISI)*, Kolkata, India
– Scored **93.9%** in aggregate.

2015–2017 **Higher Secondary (12th Grade) Examination**, *Ramakrishna Mission Boys' Home, Higher Secondary School, Rahara*, Kolkata
– Scored **91%** in aggregate, with 100 in Mathematics and 99 in Statistics.

2005–2015 **Secondary (10th Grade) Examination**, *Ramakrishna Mission Boys' Home, Higher Secondary School, Rahara*, Kolkata
– Scored **87.1%** in aggregate, with 100 in Mathematics.

Areas of interest

- Causal Inference
- Nonparametric Inference
- Random Graphs
- Analysis of Network Data
- Random Matrix Theory
- High-dimensional Statistics
- Matrix Completion
- Analysis of Functional Data

Academic achievements

2021 **ISIAA – Mrs. M.R.Iyer Memorial Gold Medal** for the highest overall score in the B.Stat course at ISI, Kolkata.

2021 **Nikhilesh Bhattacharyya Memorial Gold Medal** for outstanding performance in Statistics and Probability in the B.Stat course at ISI, Kolkata.

2020 Selected for a prestigious **Summer Research Program** at the *Duke University, Dept. of Statistical Science*. The program was cancelled later due to Covid-19.

2019, 2018 Selected for the prestigious **Madhava Nurture Camp** at the *Chennai Mathematical Institute*, Siruseri, Chennai (2019) and *St. Xavier's College,* Kolkata (2018).

2018 Felicitated from ISI Kolkata for performing well in the **Simon Marais Mathematics Competition 2018**.

2017 Ranked **2nd** in the B.Stat entrance examination of ISI. Also cleared the B.Sc entrance examination of Chennai Mathematical Institute (CMI).

2016 Achieved a **certificate of merit** for performing at a promising level in **Indian National Mathematical Olympiad (INMO) 2016**, organized by the NBHM, Govt. of India. This is awarded to the top 75 participants in the country.

2016 Selected for the **INMO 2016 training camp** at ISI, Kolkata.

Papers

1. **Ghosh, A.**, Deb, N., Karmakar, B., & Sen, B. (2021+). Efficiency of Regression (Un)-Adjusted Rosenbaum's Rank-based Estimator in Randomized Experiments. *arXiv preprint arXiv:2111.15524*. (Available at https://arxiv.org/abs/2111.15524)
2. **Ghosh, A.** (2019). An asymptotic formula for the Chebyshev theta function. *Notes on Number Theory and Discrete Mathematics*, 25(4), 1-7. (Available at https://nntdm.net/volume-25-2019/number-4/1-7/)

Master's dissertation

Title **Rank and Matching based estimation of Treatment Effect in Causal Inference**

Supervisor Dr. Bodhisattva Sen (Department of Statistics, Columbia University)

Description A completely randomized experiment allows us to estimate the causal effect by the difference in the averages of the outcome under the treatment and control. But, difference-in-means type estimators behave poorly if the potential outcomes have a heavy-tail, or contain a few extreme observations. We study an alternative estimator by Rosenbaum that estimates the causal effect by inverting a randomization test using ranks. We establish asymptotic properties of this estimator and derive a consistent estimator of its asymptotic standard error which yields a readily computable, asymptotically valid confidence interval for the treatment effect, thereby alleviating the expensive numerical calculations needed to implement Rosenbaum's original proposal. Further, we propose and study a regression adjusted version of Rosenbaum's estimator to incorporate additional covariate information in randomization inference. We prove gain in the efficiency by this regression adjustment method under a linear regression model. (See https://arxiv.org/abs/2111.15524 for details.)
Matching is another method of adjusting for covariates when estimating the average treatment effect, especially in observational studies. Despite its popularity, the large sample properties of nearest-neighbor matching estimators with a fixed number of matches are not very attractive (Abadie and Imbens, 2006). We plan to explore this area of research too, and believe that by undertaking a more systematic and complete study of nearest-neighbor matching estimators, we can improve some of the existing theoretical results in this area.

Summer projects/internships

Summer 2021 **Rank and Matching based estimation of Treatment Effect in Causal Inference**
– **Guide:** Dr. Bodhisattva Sen (Department of Statistics, Columbia University)
– Continued the project as Master's dissertation.

Summer 2019 **Method of Moments in Probability Theory.**
– **Guide:** Dr. Arijit Chakrabarty (SMU, ISI, Kolkata)
– Learned the method of moments by deriving certain results on my own, including Hoeffding's CLT for U-Statistics or Wigner's semi-circle law in Random Matrix Theory.

Summer 2019 **Summer Internship in Cryptology**, offered by the *R. C. Bose Centre for Cryptology and Security*, ISI, Kolkata.
– **Guide:** Dr. Rana Barua (SMU, ISI, Kolkata)
– Studied Elliptic Curve Cryptography, Pseudo-random functions, and Hash functions.

Spring-Summer 2018 An **independent study** on Analytic Number Theory.
– Obtained a new asymptotic formula for the Chebyshev theta function.
– Published in a journal (https://nntdm.net/volume-25-2019/number-4/1-7/)

Class projects

Fall 2020 **On Age-dependent Branching Processes (ADBP) with/without Immigration**, a group project with classmates Wribhu Banik and Shouvik Middey, as a part of the Stochastic Processes course in M.Stat 1st Year.
– **Guide:** Dr. Soumendu Sundar Mukherjee (ISRU, ISI, Kolkata)
– Reviewed the literature on ADBP with or without immigration. Presented criticisms, accompanied by simulations, against a procedure proposed by Hyrien, et al. (2015) to test homogeneity of the immigration process of an ADBP with immigration.

Fall 2020 **Analyzing a Lower Back Pain Data**, a group project with classmates Anik Burman and Soham Das, as a part of the Regression Techniques course in M.Stat 1st Year.
– **Guide:** Dr. Kiranmoy Das (ISRU, ISI, Kolkata)
– Used variable selection methods and penalized regression to determine important covariates that affect lower back pain in human beings.

Summer 2020 **Finding Anomalies in a Coal Quality data of Coal India Limited**, a group project with classmates Soham Das and Arjama Das, as a part of the Statistics Comprehensive course in B.Stat 3rd Year.
– **Guide:** Dr. Debashis Sengupta (ASU, ISI, Kolkata)
– Proposed simple data visualization tools and regression techniques to raise flags for anomalies in a coal quality data. Also used variable selection methods to identify the main factors causing the anomalies.

Spring 2020 **Typical Distance between Two Randomly Selected Vertices of a Erdős-Rényi Binomial Random Graph**, a joint project with classmate Sayak Chatterjee, as a part of the Random Graphs course in B.Stat 3rd Year.
– **Guide:** Dr. Antar Bandyopadhyay (SMU, ISI, Delhi)
– Studied through simulations the typical graph distance in an Erdős-Rényi binomial random graph, when p is above the connectivity threshold or in the sparse but super-critical regime. Also studied the typical distance in the square lattice percolation.

Talks

Fall 2021 **(Invited talk)** D. Basu Memorial Lecture, ISI, Kolkata
Title: Large low-rank matrix completion.

Summer 2021 **(Invited talk)** Online Reading Group on Functional Data Analysis
Title: Two-sample testing of the equality of mean functions.

Spring 2021 **(Invited talk)** Students' Learning Seminar, ISI, Kolkata
Title: Matching Estimators in Causal Inference.

Summer 2020 Presented the paper 'What we look at in paintings : a comparison between experienced and inexperienced art viewers' (Ylitalo, Särkkä, and Guttorp. (2016). *Ann. Appl. Stat.* 10 (2) 549 - 574), as a part of the Statistics Comprehensive course in B.Stat.

Technical skills

R, C, LaTeX, R markdown, HTML, MS-Office, GeoGebra.

Other information

Languages Bengali (mother tongue), English (fluent), Hindi (conversational).

Teaching
- Trained a number of students for Mathematical Olympiads and the entrance examinations of ISI, CMI, and other colleges.
- Maintaining a blog ghoshadi.wordpress.com aimed at helping high-school students prepare for Mathematical Olympiads and similar competitions.

I hereby declare that all the information provided above are true to the best of my knowledge.

Aditya Ghosh.

December 1, 2021