

# Aditya Ghosh

## Curriculum Vitae

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## Education

- 2022–Present **Ph.D. in Statistics**, *Stanford University*, Stanford, CA, United States  
– Will join in Fall 2022.
- 2020–2022 **Masters of Statistics (M.Stat)**, *Indian Statistical Institute (ISI)*, Kolkata, WB, India  
– Theoretical Statistics specialization  
– Scored **93.9%** in aggregate.
- 2017–2020 **Bachelor of Statistics (B.Stat)**, *Indian Statistical Institute (ISI)*, Kolkata, WB, India  
– Scored **93.9%** in aggregate.
- 2015–2017 **Higher Secondary (12<sup>th</sup> 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 (10<sup>th</sup> 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

Flexible and keen to explore other areas of Statistics and Probability as well.

## Publications

1. **Ghosh, A.**, Deb, N., Karmakar, B., & Sen, B. (2021+). Efficiency of Regression (Un)-Adjusted Rosenbaum's Rank-based Estimator in Randomized Experiments. *Submitted*. (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/>)

## 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 **2<sup>nd</sup>** 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.

## Master's dissertation

- Title** **Efficiency of Regression (Un)-Adjusted Rosenbaum's Rank-based Estimator in Randomized Experiments**
- 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, the mean-based 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. Using the asymptotic breakdown point of this estimator, we show that it provably more robust than the difference-in-means estimator. We also obtain the limiting distribution of this estimator and develop a framework to compare the efficiencies of different estimators of the treatment effect in the setting of randomized experiments. In particular, we show that the asymptotic variance of Rosenbaum's estimator is, in the worst case, about 1.16 times the variance of the difference-in-means estimator, and can be much smaller when the potential outcomes are not light-tailed. Further, we propose a regression adjusted version of Rosenbaum's estimator to incorporate additional covariate information in randomization inference. We prove gain in efficiency by this regression adjustment method under a linear regression model. Finally, we illustrate through synthetic and real data that these rank-based estimators, regression adjusted or unadjusted, are efficient and robust against heavy-tailed distributions, contamination, and various model misspecifications.

## 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 1<sup>st</sup> 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 1<sup>st</sup> 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 3<sup>rd</sup> 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 3<sup>rd</sup> 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.

## Technical skills

R, C,  $\text{\LaTeX}$ , R markdown, HTML, MS-Office, GeoGebra.

## Talks

- Summer 2022 **(Invited talk)** PCM Memorial Lecture, ISI, Kolkata  
**Title:** The Synthetic Control method in Causal Inference.
- 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.

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## Standardized test scores

Aug 07, 2021 **TOEFL:** 105 (Reading 28 + Listening 23 + Speaking 25 + Writing 29)

Oct 06, 2021 **GRE:** Verbal 152 + Quant 170 + Analytic Writing 4.0

Oct 23, 2021 **Subject GRE (Mathematics):** 900 (94<sup>th</sup> percentile)

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## 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](https://ghoshadi.wordpress.com) aimed at helping high-school students prepare for Mathematical Olympiads and similar competitions.

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

*Aditya Ghosh.*

August 24, 2022