Arindam Banerjee

Mathematics 320
Indian Institute of Technology Kharagpur
Kharagpur, West Bengal India

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RESEARCH
INTERESTS

- Combinatorial and Homological Methods in Commutative Algebra and Algebraic Geometry.

- Application of Algebra and Combinatorics in Statistics, Network Theory and Machine Learning with a special focus on the study of medically significant biological networks.

CURRENT
POSITION

Assistant Professor of Mathematics at
Indian Institute of Technology Kharagpur

PREVIOUS
POSITION

- Assistant Professor of Mathematics at
  Ramakrishna Mission Educational and Research Institute
  September 2017- October 2021

- Golomb Visiting Assistant Professor of Mathematics at Purdue University
  August 2015-July 2017

VISITING
POSITIONS

- Visitor at Tata Institute of Fundamental Research, Mumbai
  January 2020

- Visitor at Einstein Institute of Mathematics, Hebrew University,
  Jerusalem March 2019

- Visitor at University of Virginia, Charlottesville Virginia,
  November 2018

- Visitor at Vietnam Institute of Advanced Studies In Mathematics,
  Hanoi March 2018

- Visiting Scientist at Indian Statistical Institution, Kolkata
  June 2015-July 2015 and August 2017

- Visitor at Tata Institute of Fundamental Research, Mumbai
  under Visiting Student Research Program, Summer 2006.

EDUCATION   **University of Virginia**, Charlottesville, VA, USA

    Ph.D.(Mathematics)   *Completed:* May 2015
- Thesis Topic: *Castelnuovo-Mumford Regularity and Edge Ideals*
- Advisor: Professor Craig Huneke

University of Kansas, Lawrence, KS, USA

    M.A. (Mathematics)   *Completed:* Summer 2012

Institute of Mathematical Sciences, Chennai, India

    Junior Research Fellow (Mathematics)   July 2008-June 2009

Indian Statistical Institute, Kolkata, India

    M.Math.   *Completed:* May 2008

    B.Stat.   *Completed:* May 2006

PUBLICATIONS

1. The regularity of powers of edge ideals, J. Algebraic Combin., 41 (2015), no. 2, 303-321.

2. Localization and polarization of Lyubeznik numbers, with Luis Núñez-Betancourt and Kohji Yanagawa, J. Pure and Applied Alg., 219 (2015), no.11, 4872-4888.

3. Regularity three bipartite edge ideals, with Ali Alilooee, J. Commut. Alg., 9 (2017), no.4, 441-454.

4. Regularity of path ideals of gap free graphs, J. Pure and Applied Alg., 221 (2017), no.10, 2409-2419.

5. Graph Connectivity and Binomial Edge Ideal, with Luis Núñez-Betancourt, Proc. Amer. Math Soc., 145 (2017), no.2, 487-499.

6. The powers of unmixed bipartite edge ideals, with Vivek Mukundan, J. Algebra and Appln., vol. 18, no. 11, 1950209 (2019).

7. Cohen Macaulay bipartite graphs and regular element on the powers of bipartite edge ideals, with Vivek Mukundan, Open access journal on mathematics (MDPI), Current Trends on Monomial and Binomial Ideals (Invited Paper), (to appear).

8. Regularity of edge ideals and their powers, with with Selvi Bayerlsan and Huy Tài Hà, Springer Proceedings in Mathematics and Statistics, Advances in Algebra, SRAC 2017, Mobile, Alabama, USA, March 17-19, 17-52.

9. Regularity of powers of edge ideals: from local properties to global bunds, with Selvi Bayerlsan and Huy Tài Hà., Algberaic Combin., (to appear).

10. Generalized Hilbert-Kunz function of the Rees algebra of the face ring of a simplicial complex, with K. Goel and J. K. Verma, Contemporary Mathematics by American Mathematical Society,
special volume, (to appear)

11. JAK/STAT pathway and extrapolation to drugs and viruses including COVID-19, with R.P. Goswami and M. Chatterjee, Scientific Reports (Nature), 11, 2512 (2021).

12. Packing properties of cubic squarefree monomial ideals, with Ali Alilooee , J. Algebraic Combin., (to appear).

13. Regularity of powers of squarefree monomial ideal, with Bidwan Chakraborty, Kanoy Kumar Das, Mousumi Mandal and S. Selvaraja, J. Pure and Applied Alg., (to appear in 226, 2022 no.2).

14. Powers of Edge Ideals of Weighted Oriented Graphs with Linear Resolutions , with K.Das and S. Selvaraja , J. Algebra and Its Applications, (to appear).

15. Bounds for Regularity of Products of Edge Ideals, with S.Selvaraja and P. Das., Algebraic Combinatorics.

PAPERS SUBMITTED OR UNDER PREPARATION

1. Graph Theoretic Analysis of Rheumatoid Arthritis and Chronic Myeloid Networks: Identification of Putative Molecular Drug Targets, with R.P. Goswami and S. Pal.

2. Regularity of Products of Edge Ideals, with S.Selvaraja and P. Das. (Submitted)

3. Combinatorics of cubic monomial ideals, symbolic powers and packing problem, with A.Alilooee (Submitted.)

4. Some combinatorial properties of determinantal type ideals via initial ideals, with D. Ghosh and S. Selvaraja (Submitted).

5. Regularity of Powers of Edge Ideals Via Suspension, with E. Nevo (Submitted)

6. Verifiability of Stillman's Question, with Guilio Caviglia. (Preprint).

7. Random edge ideals, with D. Yogeshwaran. (In Preparation).

8. Linear resolutions and Symbolic Powers of Edge Ideals of Weighted Oriented Graphs, with K.Das and S. Selvaraja (In Preparation).

9. Clique-Cycle Powers of Edge Ideals, with K. Das and A. Alilooee (In Preparation).

10. SIR model with Immunity Function and Polynomial Solutions, M. Chatterjee, R.P. Goswami and K.Gwirtz (In Preparation).

FUTURE
RESEARCH
PLAN

Research Projects Planned for Future:

- Homological Algebra of Ideals Related to Graphs

- Symbolic Powers of Ideals

- Hilbert Kunz Multiplicity and Characteristic p Methods in Commutative Algebra

- Random Monomial Ideals

- Algebraic and Combinatorial Study of Medically Significant Networks

- Machine Learning Methods of large biological networks.

- Algebraic Methods for Inference on Stiefel Manifold

SCHOLARSHIPS, Research Fellowships and Awards

AWARDS AND
FUNDINGS
RECEIVED

• Visitor Support Grant from VIASM, Vietnam	March 2018
• DST Inspire Faculty Award	July 2017
• Graduate research assistant of Professor Craig Huneke at University of Virginia, funded by NSF	Spring 2014
• Graduate research assistant of Professor Craig Huneke at University of Kansas, funded by NSF	Spring 2012 Summers 2011, 2012
• CSIR NET Fellowship for PhD	2008
• National Board of Higher Mathematics (India) scholarship for PhD	2008
• National Board of Higher Mathematics (India) scholarship for masters students	2006-2008
• Good Performance award in form of book grant as an M.Math student at Indian Statistical Institute	2007

- Third Prize in Hindu School (Kolkata) Science Club
  Science Competition   1999

Travel Grant
- Huskey Travel Grant at University of Virginia   Spring 2014

PHD AND MASTERS STUDENTS

PhD Students
- Kanoy Kumar Das, Third year PhD student, Working on Symbolic Powers of Monomial Ideals. He has submitted two papers. He has CSIR NET PhD fellowship.

- Shirajul Haque, Second Year PhD student, Reading research papers on random monomial ideals. He has NBHM PhD fellowship.

Masters Students
- Kanoy Kumar Das (Graduated in 2018), Worked on a paper on Associated Primes by Yongwei Yao.

- Aritra Biwas, (Graduated in 2018), Worked on Associated Primes of monomial ideals.

- Sanjay Mukherjee, (Graduated in 2019), Worked on Enumerative Combinatorics and proved some new results.

COLLABORATING INSTITUTES

- Department of Mathematics, University of Virginia, USA

- Department of Mathematics, Purdue University, USA

- Department of Computer Science, Ohio State University, USA

- Department of Mathematics, Tulane University, USA

- Department of Mathematics, University of Utah, USA

- Department of Bioinformatics and Biostatistics, University of Louisville, USA

- Department of Computer and Information Science and Engineering, University of Florida, USA

- Einstein Institute of Mathematics, Hebrew University, Israel

- Department of Mathematics, CIMAT, Mexico

- Vietnam Institute of Advanced Studies in Mathematics, Vietnam

- IIT, Mumbai, India

- IIT, Gandhinagar, India

- IIT, Delhi, India

- IIT, Chennai, India,

- ISI, Bangalore, India

- ISI, Kolkata, India

- CMI, Chennai, India

- IMSc, Chennai, India

- AIIMS, Delhi, India

INVITED TALKS
- KUMUNU Jr., University of Nebraska, Lincoln   April 2012
  Title: Bounds on Castelnuovo-Mumford Regularity
- Algebra Seminar, University of Kansas, Lawrence   September 2014
  Title: Regularity of monomial ideals related to simple graphs.
- AMS Sectional Meeting, Lubbock TX   April 2014
  Title: Regularity of powers of Edge Ideal
- AMS Sectional Meeting, Lubbock TX   April 2014
  Title: Regularity of powers of Edge Ideal
- Joint Mathematical Meeting, San Antonio TX,   January 2015
  Title: Regularity of powers of Edge Ideal
- Algebra Seminar, Tulane University, New Orleans LA   February 2015
  Title: Regularity of Path Ideals
- Algebra Seminar, George Mason University, Arlington VA   May 2015
  Title: Algebra of Graphs
- Seminar at Staistics Mathematics Unit, Indian Statistical Institute,
  Kolkata, India   June 2015
  Title: Algebra of Graphs
- AMS Sectional Meeting, Memphis TN   October 2015
  Title: Regularity of Path Ideals
- Seminar, Chennai Mathematical Institute,
  Chennai, India   January 2016
  Title: Graph Connectivity and Binomial Edge Ideals
- Algebra Seminar, Tulane University, New Orleans, LA   February 2016
  Title: Edge Ideals of Bipartite Graph
- Algebra Seminar, Tulane University, New Orleans, LA   October 2016
  Title: Verifiability of Stillman's Question
- Commutative Algebra Seminar, University of Virginia,
  Charlottesville, VA   November 2016

Title:Edge Ideals of Bipartite Graph
- AMS Sectional Meeting, Charlotte NC,   April 2017
  Title: Graph Connectivity and Binomial Edge Ideals
- Seminar at Department of Mathematics, Indian Institute of Science, Bangalore, India   June 2017
  Title: Algebra of Graphs
- Seminar at Statistics-Mathematics Unit, Indian Statistical Institute, Bangalore, India   June 2017
  Title: Algebra of Graphs
- National Conference on Commutative Algebra and Algebraic Geometry, IISER Pune   December 2017
  Title:Homological Algebra of Path Ideals
- Seminar at Vietnam Institute of Advanced Studies in Mathematics, Hanoi, Vietnam   March 2018
  Title: Regularity of Powers of Edge Ideals
- Seminar at Vietnam Institute of Advanced Studies in Mathematics, Hanoi, Vietnam   March 2018
  Title: Unmixed Bipartite Graphs
- Lecture Series at Department of Mathematics,
  Indian Institute of Technology, Kharagpur   July 2018
  Title: Symbolic Powers and Packing Problem
- Conference on Combinatorial Commutative Algebra and Representation Theory,
  Tulane University, New Orleans, LA   November 2018
  Title:Regularity of Edge Ideals: Some Recent Developments
- Algebra Seminar
  Purdue University, West Lafayette, IN   November 2018
  Title:Regularity of Edge Ideals: Some Recent Developments
- Algebra and Combinatorics Seminar
  Einstein Institute of Mathematics, Hebrew University,
  Jerusalem, Israel   March 2019
  Title: Algebra of Graphs
- National Conference on Commutative Algebra and Algebraic Geometry, IISER Bhopal   June 2019
  Title: Symbolic Powers of Edge Ideals
- Virtual Commutative Algebra Seminar ,
  IIT Mumbai   June 2020
  Title: An introduction to Absolute Integral Closure
- Virtual Commutative Algebra Seminar ,
  IIT Mumbai   August 2020
  Title: Lyubeznik Numbers

TEACHING
EXPERIENCE
- Assistant Professor, Ramakrishna Mission Vivekananda Educational and Research Institute

Instructor, Masters Course in Algebraic Topology	Spring 2020
Instructor, Masters Course in Topology	Fall 2019
Instructor, Research Course in Commutative Algebra	Fall 2017 and Spring 2019
Instructor, Masters Course in Linear Algebra	Spring and Fall 2018
Instructor, Masters Course in Advanced Statistics For Big Data Analytics (with R)	Springs 2019 and 2021

- Golomb Visiting Assistant Professor, Purdue University

Instructor, Linear Algebra (with MATLAB)	Fall 2015, 2016 and Spring 20016
Instructor, Differential Equation (with MATLAB)	Spring 2017

- Graduate Teaching Assistant, University of Virginia

Instructor, Financial Mathematics	Spring 2013
Instructor, Calculus 2	Fall 2013

- Graduate Teaching Assistant, University of Kansas

Instructor, Calculus 2	Fall 2010, Spring 2011
Instructor, Calculus 1(Enhanced Section)	Fall 2011
Teaching Assistant, Calculus 1	Fall 2012
Teaching Assistant, Elementary Statistics (Partially Online Course)	Spring 2010
Instructor, Applied Calculus 1	Fall 2009

SOFTWARE SKILLS

- Computer Algebra: Macaulay 2, Singular

- Linear Algebra: MATLAB

- Statistics: R (with emphasis on Bioconductor and igraph Packages), MS Excel

- General: C, Latex

STUDENT ADVISING

- PhD Students: 2 Ongoing

- Masters Students: 3 Completed

- Undergraduate Students: 2 students from Chennai Mathematical Institute did projects with me

Service	• Organized a Conference on Commutative Algebra and Related Topics on Nov 1-2 2019.
	• Was part of Interview Board for NBHM Scholarship for PhD and Masters
	• Refereed articles for Journal of Algebraic Combinatorics, Journal of Algebra, Communications in Algebra, Journal of Algebra and Its Application, Algebraic Combinatorics
	• Reviewed for MathSciNet
	• Was judge for the Undergraduate Research Symposium, Spring 2014 for The Undergraduate Research Network at University of Virginia
	• Was involved with University of Virginia campus chapter of UNICEF
	• Was part of JBNSTS scholarship interview board.

References	• Craig Huneke
	  Department of Mathematics
	  University of Virginia
	  Email: huneke@virginia.edu

	• Bernd Ulrich
	  Department of Mathematics
	  Purdue University
	  Email: ulrich@math.purdue.edu

	• Giulio Caviglia
	  Department of Mathematics
	  Purdue University
	  Email: gcavigli@purdue.edu

	• Rafael H. Villarreal
	  Departamento de Matemticas
	  Centro de Investigaci on y de Estudios Avanzados del IPN
	  Email: vila@math.cinvestav.mx

	• Huy Tài Hà
	  Department of Mathematics
	  Tulane University
	  Email:tai@math.tulane.edu

- Amartya Kumar Dutta (Teaching Reference)
    Statistics and Mathematics Unit
    Indian Statistical Institute
    Email:amartya.28@gmail.com