Curriculum Vitae Tobias Boege

Personal information

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Education and Work Experience

Sep 2024 – Aug 2026 Marie Skłodowska-Curie Actions postdoctoral fellow
UiT The Arctic University of Norway, Tromsø.

Sep 2023 – Dec 2023 Visiting scholar at the Institute for Mathematical and Statistical Innovation (IMSI), Chicago.

Sep 2023 – Sep 2024 Postdoc in the group of Liam Solus at KTH Stockholm.

Sep 2022 – Sep 2023 Postdoc in the group of Kaie Kubjas at Aalto University, Espoo.

Oct 2021 – Sep 2022 Postdoc in the Non-linear Algebra group of Bernd Sturmfels at the Max-Planck Institute for Mathematics in the Sciences, Leipzig.

Oct 2018 – Oct 2021 PhD studies at OvGU Magdeburg within the research training group "Mathematical complexity reduction" (MathCoRe).
Thesis title: *The Gaussian conditional independence inference problem*; advisors: Thomas Kahle and Volker Kaibel.
Defense on 22 April 2022 with total predicate **summa cum laude**.

Oct 2016 – Oct 2018 Master of Science in Mathematics with honors at University of Magdeburg, with secondary subject Computer science.

Oct 2013 – Nov 2016 Bachelor of Science in Mathematics with honors at University of Magdeburg, with secondary subject Computer science.

Grants

2024 – 2026 Marie Curie postdoctoral fellowship at UiT Tromsø, Norway, with the project *ALGETIQ: Algebraic theory of information quantities* (210 911€).

Fall 2023 Visitor scholarship at the Institute for Mathematical and Statistical Innovation (IMSI), Chicago.

Awards and honors

Apr 2025	Participant in the 12th Heidelberg Laureate Forum.
Nov 2022	"FAIRest MathRepo page of 2022" research data award for *Selfadhesivity in Gaussian conditional independence structures*: https://mathrepo.mis.mpg.de/SelfadhesiveGaussianCI/index.html.
Sep 2022	Best doctoral dissertation of the University of Magdeburg.
Oct 2018	Best M.Sc. graduate of the Mathematics department in Magdeburg.
Nov 2016	Best B.Sc. graduate of the Mathematics department in Magdeburg.

Research

Research interests. My research focuses on applications of algebra to statistics, information theory and computational geometry. I am particularly interested in independence structures and graphical models and how their statistical characteristics (and shortcomings!) depend on their properties as geometric spaces. I am a proponent of experimental and computational mathematics. As a result I care deeply about data, heuristic methods, and post-hoc certification using exact computations.

Preprints under review.

- Carlos Améndola, Tobias Boege, Benjamin Hollering, and Pratik Misra. *Structural identifiability of graphical continuous Lyapunov models*. 2025. arXiv: 2510.04985 [math.ST].
- Tobias Boege, Kamillo Ferry, Benjamin Hollering, and Francesco Nowell. *Polyhedral Aspects of Maxoids*. 2025. arXiv: 2504.21068 [math.CO].
- Tobias Boege. *On the Intersection and Composition properties of conditional independence*. 2025. arXiv: 2504.11978 [cs.IT].
- Tobias Boege. *The entropy profiles of a definable set over finite fields*. 2025. arXiv: 2502.20355 [cs.IT].
- Tobias Boege and Liam Solus. *Real birational implicitization for statistical models*. 2024. arXiv: 2410.23102 [math.ST].
- Tobias Boege, Jesse Selover, and Maksym Zubkov. *Sign patterns of principal minors of real symmetric matrices*. 2024. arXiv: 2407.17826 [math.CO].

Published papers.

- Tobias Boege, Kaie Kubjas, Pratik Misra, and Liam Solus. "Coloured Gaussian directed acyclic graphical models". In: *Journal of the Royal Statistical Society Series B: Statistical Methodology* (2025). DOI: 10.1093/jrsssb/qkaf068.
- Tobias Boege, Mathias Drton, Benjamin Hollering, Sarah Lumpp, Pratik Misra, and Daniela Schkoda. "Conditional independence in stationary diffusions". In: *Stochastic Processes and their Applications* (2025). DOI: 10.1016/j.spa.2025.104604.
- Tobias Boege, Janneke H. Bolt, and Milan Studený. "Self-adhesivity in lattices of abstract conditional independence models". In: *Discrete Applied Mathematics* 361 (2025), pp. 196–225. ISSN: 0166-218X. DOI: 10.1016/j.dam.2024.10.006.
- Tobias Boege, René Fritze, Christiane Görgen, Jeroen Hanselman, Dorothea Iglezakis, Lars Kastner, Thomas Koprucki, Tabea Krause, Christoph Lehrenfeld, Silvia Polla, Marco Reidelbach, Christian Riedel, Jens Saak, Björn Schembera, Karsten Tabelow, and Marcus Weber. "Research-Data Management Planning in the German Mathematical Community". In: *EMS Magazine* (2023). DOI: 10.4171/MAG/152.
- Tobias Boege. "Algebra in probabilistic reasoning". In: *Computeralgebra-Rundbrief* 71 (2022), pp. 15–20.
- Tobias Boege. "The Gaussian conditional independence inference problem". PhD thesis. OvGU Magdeburg, 2022. DOI: 10.25673/86275.
- Tobias Boege. "Selfadhesivity in Gaussian conditional independence structures". In: *International Journal of Approximate Reasoning* (2023). ISSN: 0888-613X. DOI: 10.1016/j.ijar.2023.109027.
- Tobias Boege. "No Eleventh Conditional Ingleton Inequality". In: *Experimental Mathematics* 33.4 (2024), pp. 808–816. DOI: 10.1080/10586458.2023.2294827.
- Tobias Boege, Sonja Petrović, and Bernd Sturmfels. "Marginal Independence Models". In: *Proceedings of the 2022 International Symposium on Symbolic and Algebraic Computation*. ISSAC '22. Villeneuve-

d'Ascq, France: Association for Computing Machinery (ACM), 2022, pp. 263–271. DOI: 10.1145/3476446.3536193.
- Tobias Boege, Thomas Kahle, Andreas Kretschmer, and Frank Röttger. "The geometry of Gaussian double Markovian distributions". In: *Scandinavian Journal of Statistics* 50.2 (2023), pp. 665–696. DOI: 10.1111/sjos.12604.
- Tobias Boege. *Incidence geometry in the projective plane via almost-principal minors of symmetric matrices*. 2021. arXiv: 2103.02589 [math.ST].
- Tobias Boege. "Gaussoids are two-antecedental approximations of Gaussian conditional independence structures". In: *Ann. Math. Artif. Intell.* 90 (2022), pp. 645–673. DOI: 10.1007/s10472-021-09780-0.
- Tobias Boege, Jane Ivy Coons, Christopher Eur, Aida Maraj, and Frank Röttger. "Reciprocal Maximum Likelihood Degrees of Brownian Motion Tree Models". In: *Le Matematiche* 76.2 (2021), pp. 383–398. DOI: 10.4418/2021.76.2.6.
- Tobias Boege and Thomas Kahle. "Construction Methods for Gaussoids". In: *Kybernetika* 56.6 (2020), pp. 1045–1062. DOI: 10.14736/kyb-2020-6-1045.
- Tobias Boege, Alessio D'Alì, Thomas Kahle, and Bernd Sturmfels. "The Geometry of Gaussoids". In: *Found. Comput. Math.* 19.4 (2019), pp. 775–812. DOI: 10.1007/s10208-018-9396-x.
- Tobias Boege. *On permutations with decidable cycles*. B.Sc. thesis. 2016. arXiv: 1612.05136 [math.LO].

Conference talks.

- Algebraic methods in dynamics and particle physics, MPI-SWS Saarbrücken: "Causality and independence in stationary diffusions".
- 13th Workshop on Uncertainty Processing, June 2025, Třešť: "On the Intersection and Composition properties for discrete random variables".
- Algebraic Statistics, March 2025, München: "Real birational implicitization for statistical models".
- Mørketidens Mattemøte, January 2025, Tromsø: "Polyhedra in information theory".
- AlToGeLiS Day, May 2024, Dresden: "Algebra in probabilistic reasoning".
- Combinatorial Coworkspace, March 2024, Kleinwalsertal: "The Ingleton inequality for random variables".
- Graduate Student Meeting on Applied Algebra and Combinatorics, April 2023, KTH Stockholm: "Matroids in information theory: conditional Ingleton inequalities".
- Workshop on Algebraic structures in statistical methodology, December 2022, Mathematisches Forschungsinstitut Oberwolfach: "The complexity of Gaussian conditional independence inference".
- Workshop on Algorithmic aspects of information theory, July 2022, Schloss Dagstuhl: "Universality of Gaussian conditional independence models".
- 47th International Symposium on Symbolic and Algebraic Computation (ISSAC), July 2022, Lille: "Marginal independence models".
- Annual meeting of the IMS, June 2022, London: "Gaussian conditional independence beyond graphical models".
- 12th Workshop on Uncertainty Processing, June 2022, Kutná Hora: "Selfadhesivity in Gaussian conditional independence structures".
- Tagung der Fachgruppe Computeralgebra, March 2022, München: "The laws of Gaussian conditional independence".

Teaching

- Spring 2026: Individual Special Curriculum (Master): Computer-assisted mathematics, UiT Tromsø.
- Spring 2025: Individual Special Curriculum (Master): Algebraic geometry, UiT Tromsø.
- Spring 2023: Real algebraic geometry, Aalto University.
- Winter 2020: organized and taught 5-day intensive preparation course "Financial Mathematics and Statistics" for 180 incoming economics students.
- Winter 2019: substitute tutor for "Linear Algebra I".
- Winter 2015 – Summer 2017: tutor for "Linear Algebra I and II".
- Winter 2015: tutor for "Foundations of Theoretical Computer Science I".

Student supervision

- M.Sc. thesis of Emil Verkama on "Repairing the Universality theorem for 4-polytopes" at Aalto University. This thesis won the 2024 *Ernst Lindelöf* prize of the Finnish Mathematical Society.

Societies

- Member of the Norwegian Mathematical Society.
- Member of the Fachgruppe Computeralgebra.

Service

- Co-organizer of the fall school on "Geometry in Cryptography and Communication" at UiT Tromsø, Fall 2025.
- Co-organizer of the Applied Algebra workshop, scheduled for September 2023 in Osnabrück, jointly with Paul Breiding, Lukas Gustafsson and Pierpaola Santarsiero, Tim Römer and Timo de Wolff.
- Co-organizer of the "Data and certificates in algebra and geometry" minisymposium at SIAM AG 2023, jointly with Julia Lindberg.
- Co-editor of the Oberwolfach workshop report 2249a on "Algebraic structures in statistical methodology".
- Co-organizer of the Discrete mathematics and algebra seminar at Aalto University since Fall 2022, jointly with Muhammad Ardiyansyah and Milo Orlich.
- Co-editor of the Dagstuhl seminar report 22301 on "Algorithmic aspects of information theory" contributing an extensive list of open problems gathered from the participants in informal discussions, talks and the dedicated open problem sessions.
- Co-organizer of the "Leipzig–Magdeburg seminar day" at MPI-MiS Leipzig, together with Thomas Kahle.
- Tutorial on "Mathematical Software: How to get started" at MPI-MiS Leipzig, together with Ronald Kriemann and Javier Sendra.
- Co-organizer of the Non-linear algebra seminar at MPI-MiS Leipzig in the summer term 2022 with Alessandro Neri.
- Co-organizer of the Graduate Student Meeting in Applied Algebra and Combinatorics, April 2021, Copenhagen, jointly organized with Angelica Torres, Beatriz Escudero and Benjamin Smith.
- Supervision of Garett Cunningham (Ohio Univ.) in RISE Germany internship "Formal conditional independence structures", June to August 2020.
- Organizer of the MathCoRe fellow seminar and editor of the website from Dec 2020 to Oct 2021.
- Refereed for *Duke Mathematical Journal*, *SIAM Journal on Discrete Mathematics*, *SIAM Journal on Applied Algebra and Geometry*, *Electronic Journal of Statistics*, *Algebraic Statistics*, *Arnold Mathematical Journal*, *Biometrika*, *International Journal of Approximate Reasoning*, *Journal of Machine Learning Research*, *International Mathematics Research Notices*, *Discrete Mathematics and Theoretical Computer Science*, *CLeaR*, *UAI* and *SODA* conference.

Software development

- Co-developer of the `AlgebraicStatistics` package for the computer algebra system `Oscar`.
- Developer of the `CInet::Tools` suite for computations with conditional independence structures.
- Creator of a research data repository and an emerging database on discrete structures in conditional independence `https://cinet.link`.

Skills

- Languages: German (native), English (C1 via "very good" grade in German high school diploma).
- Experience in problem modeling and solving using `SAT` (`#SAT`, `AllSAT`) solvers, linear programming and discrete geometry (`soplex`, `normaliz`) as well as computer algebra systems (`Oscar`, `Macaulay2`, `Wolfram Mathematica`).