Zhaoxi Zhang

PhD Candidate in Statistics at the University of Edinburgh

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Bayes Center 5.20, University of Edinburgh, Edinburgh, Scotland, United Kingdom

Educational Background

- **Huazhong Agricultural University, China** ***09/2017-06/2021***

  Major: Information and Computing Science
  Degree: Bachelor of Science (BSc)
  GPA: 3.78/4, 90.48/100
  Honors: Merit Student for the 2018-2019 Academic Year, Award for Academic Excellence in the 2019-2020 Academic Year, Merit Student for the 2020-2021 Academic Year, Outstanding Graduate

- **University of Edinburgh, UK** ***09/2021-08/2022***

  Programme Title: Statistics with Data Science
  Degree: Master of Science (MSc)
  Grade: Distinction

- **University of Edinburgh, UK** ***09/2022-present***

  Subject: Statistics
  Degree: Doctor of Philosophy (PhD)
  Funded by: UoE School of Mathematics PhD Studentship
  Advised by: Dr. Vanda Inácio de Carvalho, Dr. Sara Wade, and Prof. Finn Lindgren
  Research Areas: Bayesian Nonparametric methods, Statistical evaluation of biomarkers

Awards / Scholarships

- ✓ UoE School of Mathematics PhD Studentship [Issued by School of Mathematics, University of Edinburgh, starting Sep, 2022]: UKRI rate for 4 years (£20,780 in 2025/2026), SoM funding package for doctoral studies.
- ✓ Laura Wisewell Travel Scholarship [Issued by School of Mathematics, University of Edinburgh, Mar, 2023]: £500, in support of the attendance at the 37th International Workshop on Statistical Modelling (IWSM 2023).
- ✓ Laura Wisewell Travel Scholarship [Issued by School of Mathematics, University of Edinburgh, Nov, 2023]: £950, in support of the attendance at the Bayesian Young Statisticians Meeting 2024 (BAYSM 2024) and 2024 International Society for Bayesian Analysis World Meeting (ISBA 2024). *[Awarded but didn't use due to medical emergency]*
- ✓ Nomination for Student Tutor of the year in the Edinburgh University Student's Association (EUSA) Teaching Awards [2024]
- ✓ Junior Travel Award [Issued by Bayesian Nonparametric section of the International Society for Bayesian Analysis, May, 2024]: $800, in support of the attendance at the 3rd Bayesian Nonparametrics Networking Workshop (BNP Networking Workshop 2024).
- ✓ Junior Travel Award [Issued by Bayesian Nonparametric section of the International Society for Bayesian Analysis, March, 2025]: $500, in support of the attendance at the 14th International Conference on Bayesian Nonparametrics (BNP 14).
- ✓ Junior Travel Award [Issued by Bayesian Computation section of the International Society for Bayesian Analysis, May, 2025]: $250, in support of the attendance at Bayes Comp 2025.
- ✓ Early Career Travel Award [Issued by American Statistical Association, June, 2025]: $400, in support of the attendance at the 2025 Joint Statistical Meetings (JSM 2025).
- ✓ William Dickson Travelling Fund [Issued by University of Edinburgh, June, 2025]: £800, in support of the attendance at the 46th Annual Conference of the International Society for Clinical Biostatistics (ISCB 46).
- ✓ IMA Small Grant [Issued by The Institute of Mathematics and its Applications, June, 2025]: £600, in support of the attendance at the 46th Annual Conference of the International Society for Clinical Biostatistics (ISCB 46).
- ✓ Royal Statistical Society 2025 Statistical Excellence Award for Early-Career Writing [Issued by Significance magazine and the Young Statisticians Section of the Royal Statistical Society, July, 2025].

Papers

- ✓ Zhang, Z., Inácio, V., de Carvalho, M., & Wade, S. (2024, July). The underlap coefficient as a measure of a biomarker's discriminatory ability and covariate dependence in cluster analysis. In 38th International Workshop on Statistical Modelling (p. 324).

- ✓ Zhang, Z., Inácio, V., & de Carvalho, M. (2025). The underlap coefficient as a measure of a biomarker's discriminatory ability. arXiv preprint arXiv:2504.12288. [in revision]
- ✓ Zhang, Z. Early Scottish Statisticians and their lasting legacy, Significance 22.6 (2025): 42-46. (Winning Entry for the Statistical Excellence Award For Early Career Writing presented by the Royal Statistical Society)
- ✓ Zhang, Z., Inácio, V., & Wade, S. The generalized underlap coefficient with an application in clustering. arXiv preprint arXiv:2602.19473 *[Submitted]*

Talks / Poster Presentations

- ✓ "Bayesian nonparametric inference for the three-class covariate-specific overlap coefficient", The 37th International Workshop on Statistical Modelling (IWSM 2023), Dortmund, Germany, July, 2023. *[Contributed Poster]*
- ✓ "Bayesian nonparametric inference for the three-class covariate-specific underlap coefficient", The Bayesian Young Statisticians Meeting (BAYSM 2023), Online, November, 2023. *[Contributed 15-min Talk]*
- ✓ "Bayesian nonparametric inference for the ROC curve", The Maxwell Institute for Mathematical Science PG Conference, Dalkeith, UK, January, 2024. *[Invited 15-min Talk]*
- ✓ "How to evaluate diagnostic tests in the multi-class setting: from ROC based measures to the underlap coefficient", School of Mathematics PG Colloquium, Edinburgh, UK, February, 2024. *[Invited 50-min Talk]*
- ✓ "The underlap coefficient as measure of a biomarker's discriminatory ability in a multi-class disease setting", The Centre for Statistics Early Career Researchers Day 2024 (ECR day 2024), Edinburgh, UK, June, 2024. *[Invited 15-min Talk]*
- ✓ "The underlap coefficient as measure of a biomarker's discriminatory ability in a multi-class disease setting", The Centre for Statistics Annual Conference 2024 (CFS 2024), Edinburgh, UK, June, 2024. *[Contributed Poster]*
- ✓ "Measuring covariate dependence in cluster analysis based on the underlap coefficient", The Bayesian Young Statisticians Meeting (BAYSM 2024), Venice, Italy, June, 2024. *[Contributed Poster][Accepted but didn't attend due to medical emergency]*
- ✓ "The underlap coefficient as measure of a biomarker's discriminatory ability in a multi-class disease setting", 2024 International Society for Bayesian Analysis World Meeting (ISBA 2024), Venice, Italy, July, 2024. *[Contributed Poster][Accepted but didn't attend due to medical emergency]*
- ✓ "The underlap coefficient as a measure of a biomarker's discriminatory ability and covariate dependence in cluster analysis", The 38th International Workshop on Statistical Modelling (IWSM 2024), Durham, UK, July, 2024. *[Contributed Poster]*
- ✓ "The underlap coefficient as a measure of covariate dependence in cluster analysis", The 3rd Bayesian Nonparametrics Networking Workshop (BNP Networking Workshop 2024), Singapore, August, 2024. *[Contributed 25-min Talk]*
- ✓ "History of Statistics in Scotland", Lecture for visiting students from Cornell College (USA), Edinburgh, UK, October, 2024. *[Invited 1-hour Talk]*
- ✓ "Measuring dependence of partition on covariates in cluster analysis", The Bayesian Young Statisticians Meeting (BAYSM 2025), Online, April, 2025. *[Contributed 7-min Lightening Talk]*
- ✓ "The underlap coefficient as a distribution level measure of separation and its applications", The 2nd Stats Internal Research Seminar (StaIRS2), Edinburgh, UK, April, 2025. *[Invited 30-min Talk]*
- ✓ "The Underlap Coefficient: A Novel Alternative to ROC-Based Summary Measures for Evaluating Biomarkers' Discriminatory Ability in Multi-Class Settings", Statisticians in the Pharmaceutical Industry Annual Conference 2025 (PSI 2025), London, June, 2025. *[Contributed Poster]*
- ✓ "A Framework for Measuring Dependence of Partitions on Covariates in Mixture Models", Bayes Comp 2025, Singapore, June, 2025. *[Contributed Poster]*
- ✓ "Measuring dependence of partition on covariates in cluster analysis", The 14th International Conference on Bayesian Nonparametrics (BNP 14), Los Angeles, United States, June, 2025. *[Contributed Poster]*
- ✓ "Measuring dependence of partition on covariates in cluster analysis", 2025 Joint Statistical Meetings (JSM 2025), Nashville, Tennessee, United States, August, 2025. *[Contributed 15-min Talk]*
- ✓ "The underlap coefficient as measure of a biomarker's discriminatory ability in a multi-class disease setting", The 46th Annual Conference of the International Society for Clinical Biostatistics (ISCB 46), Basel, Switzerland, August, 2025. *[Contributed 20-min Talk]*
- ✓ "Early Scottish statisticians and their lasting legacy", The Royal Statistical Society International Conference 2025 (RSS 2025), Edinburgh, UK, September, 2025. *[Invited 20-min Talk]*
- ✓ "Early history of statistics in Scotland", Scottish government internal seminar invited by the office of the Chief Statistician, Edinburgh, UK, December, 2025. *[Invited 40-min Talk]*

- ✓ "Early history of statistics in Scotland", UoE School of Mathematics Statistics seminar, Edinburgh, UK, February, 2026. *[Invited 50-min Talk]*
- ✓ "The generalized underlap coefficient with an application in clustering", UoE Business School Statistics discussion group seminar, Edinburgh, UK, February, 2026. *[Invited 50-min Talk]*

Teaching Experience

- ✓ MATH10093 Statistical Computing, Teaching Assistant/ Tutor/ Marker for Projects [2023, 2024, 2025]
- ✓ MATH08051 Statistics (Year 2), Teaching Assistant/ Tutor/ Marker for Assignments and Exams [2023, 2024, 2025]
- ✓ MATH11178 Dissertation (SDS), Project Helper (Supervisory Team), Project "Understanding the impact of age demographics on hospital admissions in Scotland" and "Understanding the flow of people using GP services" [2023, 2025]
- ✓ MATH11177 Bayesian Theory, Teaching Assistant/ Tutor [2023, 2024]
- ✓ MATH11187 Generalised Regression Models, Teaching Assistant/ Tutor [2023, 2024]
- ✓ MATH10095 Statistical Methodology, Teaching Assistant/ Tutor[2023]
- ✓ MATH08077 Introduction to Data Science, Teaching Assistant/ Tutor/ Marker for Projects [2024]
- ✓ MATH11185 Incomplete Data Analysis, Teaching Assistant/ Tutor/ Marker for Projects [2025]
- ✓ MATH11176 Statistical Programming, Teaching Assistant/ Tutor/ Marker for Projects [2025]
- ✓ SMSTC Regression and Simulation Methods (PhD level) Edinburgh local group tutorial organizer/ Tutor [2025]

PhD Research

- ➢ **The underlap coefficient as measure of a biomarker's discriminatory ability in a multi-class disease setting**

Joint work with: Dr. Vanda Inacio De Carvalho and Prof. Miguel de Carvalho

The first step when evaluating a diagnostic test is to determine the variation in its values across different disease groups. In the three-class disease setting, the volume under the receiver characteristic surface (VUS) and the three-class Youden index (YI) are the commonly used summary measures of a test's discriminatory ability. However, these measures are only appropriate under a stochastic ordering assumption for the distributions of test outcomes in the three groups. This assumption is stringent, not always plausible, particularly when covariates are involved. Violating this assumption can lead to incorrect conclusions about a test's performance to distinguish between the three classes. To address this, we propose the underlap coefficient, study its properties, as well as its relationship with the VUS and YI when a stochastic order is enforced. We further propose Bayesian nonparametric estimators for both the unconditional underlap coefficient and for its covariate-specific version. A simulation study reveals a good performance of the proposed estimators across a range of conceivable scenarios. We also illustrate the proposed approach with an application to an Alzheimer's disease (AD) dataset to assess how different potential AD biomarkers distinguish between individuals with normal cognition, mild impairment, and dementia, and how age and gender impact this discriminatory ability.

- ➢ **The underlap coefficient as a measure of covariate dependence in cluster analysis**

Joint work with: Dr. Vanda Inacio De Carvalho and Dr. Sara Wade

Mixture models are invaluable tools for density estimation and clustering tasks. After obtaining a partition of responses by the mixture model, assessing the dependency of these partitions on covariates is of great importance. This is particularly relevant in applications where understanding the influence of covariates on clusters or subpopulations is crucial, such as in precision medicine for targeted interventions. In this context, we propose the use of the underlap coefficient as a metric for measuring covariate dependence in cluster analysis. Initially designed to quantify separation between distributions, we posit that the underlap coefficient can also serve as an effective complement to posterior predictive checks when using mixture models for clustering purposes. While the posterior predictive check can identify model inadequacies, the UNL offers insights into where to make model adjustments, particularly whether or not to allow weights to depend on covariates. We further propose Bayesian estimators to accurately estimate the underlap coefficient for this task.

Internship Experience

- ➢ **Digital Research Services, University of Edinburgh** ***05/2025-07/2025***

Position: DRS Ambassador scheme (Research Intern)

An interdisciplinary research programme supported by Digital Research Services to match 12 postgraduate students

with strong data and computing skills with host projects across the university every year. (https://digitalresearchservices.ed.ac.uk/training/ambassadors)

✓ Completed the project: Enhancing Secondary Mathematics through Climate Change and AI-Driven Games. The project was hosted by Dr. Hui-Chuan Li, Moray House School of Education and Sport, University of Edinburgh.

➢ **Beijing Aero-com IT Corp** ***07/2019-08/2019***

Position: Data Analysis Intern, R&D center

✓ Completed two independent projects, Flight Segment Fuel Consumption Benchmark Value & Accuracy Refinement of Landing Height at the Head of the Runway.

Other Activities

➢ **The American Statistical Association (ASA) DataFest 2024 & 2025 @ Edinburgh**

03/2024 & 03/2025

Role: Consultant

✓ Guided students in analysing the data, focusing on a small part of it and trying to answer questions that are feasible and possible to be answered by the given data in the given time frame.

➢ **ICMS and MAC-MIGS Modelling Camp 2024** ***04/2024***

Role: Participant (Winner as the Best Team of the Modelling Camp)

✓ Worked on the project "Expanding lung health initiatives across Scotland", offered the industry partner solutions to their current challenges by statistical modelling.

➢ **University Football Association** ***09/2017 - 06/2021***

Role: President (2019-2020)

✓ Coordinated and planned the undergraduate, graduate and faculty football matches on campus

✓ Responsible for the administrative work of the association, personnel management, and sports discipline rewards and punishments

Other Roles: Secretary of Organizing Department and Referee Department (2017-2018), Vice President and Head of Referee Department (2018-2019), Honorary President and Chair of Inspection Committee (2020-2021)

➢ **The 10th Model United Nations Conference, Central China Regional** ***04/2019***

Role: Operating Instructor of the Organization Committee

✓ In charge of department connection, logistics support and other tasks

➢ **The 2018 Asia and Pacific Mathematical Contest in Modeling** ***11/2018***

Role: Participant (Second Prize Winner)

✓ Completed mathematical modeling and programming

✓ Joined in writing mathematical model papers

➢ **The 9th Model United Nations Conference, Central China Regional** ***04/2018***

Role: Participant (Award of Best Speech), Sub-Venue: OECD Committee, Discussion Topic: Economics Globalization

✓ Raised opinions and discussed topics

✓ Cooperated in the draft resolution