

Nina DELIU

Researcher RTDA, MEMOTEF, Sapienza Università di Roma

Visiting Researcher, MRC – BSU, University of Cambridge

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EDUCATION

- 2021 **PhD in Methodological Statistics** (33 cycle) - Sapienza Università di Roma
Reinforcement Learning in Modern Biostatistics: Benefits, Challenges and New Proposals
Internal Supervisor: PIERPAOLO BRUTTI
External Supervisors: BIBHAS CHAKRABORTY, JOSEPH JAY WILLIAMS
- 2017 **MSc in Statistics and Decisions** - Sapienza Università di Roma
Deep Learning to the Test: an Application to Traffic Data Streams
Supervisor: PIERPAOLO BRUTTI. Grade: 110 *cum laude*
- 2016 **MSc in Mathématiques, Informatique, Décision, Organisation**
Double degree - Université Paris-Dauphine
Evidence Estimation of State Space Models: Sequential Monte Carlo² and Chib's Method
Supervisor: CHRISTIAN P. ROBERT
- 2014 **BSc in Statistics, Economics and Society** - Sapienza Università di Roma
Income distribution analysis in post-communist economies
Supervisor: ALESSANDRO RONCAGLIA. Grade: 110 *cum laude*

PROFESSIONAL EXPERIENCES

- 12/2021 – current **Sapienza Università di Roma – Researcher RTDA** (PON-DM1062)
- 02/2022 – current **University of Cambridge – Long-term Visiting Researcher**
- 11/2020 – 12/2021 **University of Cambridge – Postdoctoral Research Associate**
- 01/2020 – 03/2020 **University of Toronto – Visiting PhD Student**
- 03/2019 – 06/2019 **National University of Singapore – Visiting PhD Student**
- 06/2016 – 06/2018 **Fondazione GIMEMA, Franco Mandelli ONLUS – Biostatistician**

EXTERNAL COLLABORATIONS

- 2023 – current **NADO Italia: A Copula-based Hierarchical Framework for Doping Detection**
- 2023 – current **International Business College Mitrovica & MEMOTEF: Cultural and Scientific Collaboration Agreement (PI)**
- 2022 – current **Papworth Hospital & Cambridge University: Design of Adaptive Clinical Trials**
- 2022 – current **ISTAT: Accuracy estimation in register data**
- 2022 – current **IZI Spa: Metodi per la Stima della Soddisfazione delle Politiche di Gestione del Verde Pubblico nei Grandi Centri Urbani**
- 2021 – current **Partnership with Toronto Uni, Carnegie Mellon Uni & North Carolina State Uni**
Adaptive Experimentation Accelerator in Education
Winner of the XPRIZE \$1M Digital Learning Challenge
- 2022 – 2023 **Collaboration with Toronto Uni, Northwestern Uni & Microsoft**
[Mental Health America: Personalized Text Messaging](#)
- 2022 – 2023 **Fondazione Brodolini, INAPP: Intergenerational Learning and COVID-19**
- 2020 – 2021 **Università Urbaniana: [Multicultural and Intercultural Competencies](#)**
- 2019 – 2020 **University of California Berkeley: [DIAMANTE Adaptive Notification Tracking](#)**
- 2016 – 2018 **Fondazione GIMEMA. [PROMOTION Registry](#)**
- 2016 – 2018 **Fondazione GIMEMA, EORTC: Project Manager for the [EORTC QLQ-CML24](#)**

TEACHING

INSTRUCTOR

- 2023 – 2024 MEMOTEF, Sapienza U – **Advanced Statistics with R** (PhD Course 12h; ENG)
2023 – 2024 MEMOTEF, Sapienza U – **Time Series and Financial Time Series** (MSc Course 72h; ENG)
2022 – 2023 MEMOTEF, Sapienza U – **Time Series Analysis** (MSc Course 48h; IT)
2022 – 2023 MEMOTEF, Sapienza U – **Advanced Statistics with R** (PhD Course 28h; ENG)
2021 – 2022 MEMOTEF, Sapienza U – **Advanced Statistics with R** (PhD Course 28h; ENG)
2020 – 2021 Auxilium U – **Methods for Social Research** (MSc Course 20h; IT)
2020 – 2021 DSS, Sapienza U – **LaTeX e Beamer nella Ricerca** (Undergrad Course 10h; IT)
2019 – 2020 DSS, Sapienza U – **LaTeX e Beamer nella Ricerca** (Undergrad Course 10h; IT)
2019 – 2020 DSS, Sapienza U – **Intro to SAS** (Master II in Big Data; IT)
2019 – 2020 DSS, Sapienza U – **Intro to LaTeX and Beamer** (Master II in Big Data; IT)

TRAINING

- APR 2022 Training seminars for the Erasmus+ Programme **ResearchCult in Higher Education in Kosovo**, Pristina (Kosovo)
– *A review of the main models and techniques for data analysis* (ENG)
– *Use of LATEX for writing your research article* (ENG)

TA

- 2020 – 2021 Cambridge U – **Statistical Methods in Population Health** (MPhil Course; ENG)
2019 – 2020 DIAG, Sapienza U – **Statistics for Data Science** (MSc Course; ENG)
2018 – 2019 DIAG, Sapienza U – **Statistics for Data Science** (MSc Course; ENG)
2017 – 2018 DSS, Sapienza U – **Statistical Inference** (Undergrad Course; IT)
2017 – 2018 Economics, Roma Tre U – **Statistics for Economics** (Undergrad Course; IT)

TUTOR

- 2019 – 2020 DSS, Sapienza U – **University Master of Level II in Big Data: Statistical Methods for the Knowledge Society** (150h; IT)

GRANT APPLICATIONS

- 2024 **World Anti-Doping Agency – WADA Research Grant**, Funding of \$50K (Co-PI)
Title: *Enhancing the methodological framework for doping detection: from univariate to multivariate testing analysis on Athlete Biological Passport profiles*
- 2023 **EU Commission – HORIZON MSCA Doctoral Networks 2023** (24 Partners; €3.5M)
Title: *Statistical Methodologies for Personalised Approaches to Healthcare Delivery – Proposal rejected with a score of 88% (threshold: 70/100); to be resubmitted in 2024*
- 2022 **Sapienza U – Academic Research Project**, Funding of €3K (PI)
Title: *Development of a Methodological Framework for Enhancing the Fight Against Doping. Using Copulae for Multivariate Testing Analysis on ABP Profiles*
- 2022 **Turing Institute and Roche Partnership – Structured Missingness**, £250K (Co-I)
Title: *Personalized Cancer Treatment with Missing Data: An Optimization Approach – Proposal rejected due to budget limitations*
- 2022 **INAPP – Gara di Appalto**, Funding of €98K (Component of the research group)
Title: *Supporto all'analisi dell'impatto del coronavirus sulle pratiche di age management nei processi formativi aziendali. Il ruolo dell'intergenerational learning*
- 2019 **Sapienza U – Academic Starting Research Project**, Funding of €1000 (PI)
Title: *Contextual Bandits for Developing Personalized Mobile Health Interventions*
- 2018 **Sapienza U – Academic Starting Research Project**, Funding of €1000 (PI)
Title: *Self-reported health outcomes in cancer risk prediction using the UK Biobank*

AWARDS

- 2023 ICSDS2023 Conference – **IMS Travel Award** (\$1200)
Title: *Modeling considerations when designing experiments with reinforcement learning*
- 2023 XPRIZE – **Digital Learning Challenge Award** (\$500K)
Title: *Adaptive Experimentation Accelerator: AI experiments to enhance education*
- 2019 DLRL Summer School @ University of Alberta – **CIFAR & AMII Travel Award** (\$1750)
- 2018 SIS Annual Meeting – **Best Poster Prize 2018** (€250 + Stata Course)
Title: *Deep Learning to the Test: an Application to Traffic Data Streams*
- 2017 International Society for Quality of Life (ISOQOL) – **New Investigator Award** (\$1500)
Title: *Modelling Strategies to Improve Estimates of Prognostic Factors Analyses with PROs*
- 2014 MIUR – **Graduation Prize** (€500)

TALKS AND SEMINARS

Upcoming

- 12/2024 Invited @ **ICSDS2024**, Nice (FR)
Finite-sample and Asymptotic Error Control of a Novel Test for Response-adaptive Designs
- 09/2024 Poster @ **COPA2024**, Milano (IT)
Anomaly Detection in Multivariate Profiles with Conformal Bayesian Inference
- 06/2024 Invited @ **SIS2024**, Bari (IT)
Finite-sample inference in response-adaptive designs: an application to Thompson sampling
- 06/2024 Invited @ **BMS-ANed (the Dutch Section of the IBS)**, Rotterdam (NH)
Online sequential-decision making via bandit algorithms

2024

- 05/2024 Contributed @ **AUEB Sports Analytics Workshop 2024**, Athens (GR)
A Multivariate Copula-based Conformal Bayesian Framework for Doping Detection
- 05/2024 Seminar @ **Department of Statistical Sciences**, University of Padua (IT)
Designing experiments via bandit algorithms: modeling considerations for better outcomes
- 04/2024 Keynote @ **ALBECS-2024**, Australia (online)
Designing adaptive experiments via bandits: modeling considerations for better outcomes
- 03/2024 Contributed @ **MEMOTEF Research Days 2024**, Sapienza (IT)
Reinforcement learning for sequential decision-making: from healthcare to finance
- 02/2024 Invited @ **RAR Workshop**, University of Cambridge (UK)
Thompson sampling for zero-inflated count data in mobile health trials

2023

- 12/2023 Invited @ **ICSDS 2023**, Lisbon (PR)
Modeling considerations when designing experiments with reinforcement learning
- 09/2023 Invited @ **StaTalk 2023**, Roma (IT)
On the finite-sample and asymptotic validity of an allocation-probability test for adaptively-collected data
- 09/2023 Invited @ **Bayesian Day 2023**, Roma (IT)
Enhancing Patient Outcomes and Statistical Efficiency in Rare Disease Phase-II Trials
- 08/2023 Invited @ **JSM 2023**, Toronto (online)
An Allocation-probability Test for Adaptive Experiments
- 08/2023 Poster @ **ISCB 2023**, Milano (IT)
Enhancing Patient Outcomes and Statistical Efficiency in Rare Disease Phase-II Trials
- 08/2023 Contributed @ **EcoSta 2023**, Tokyo (JP)
Probabilistic and Distance-based Approaches for Computing Highest-Density Regions
- 06/2023 Contributed @ **SIS 2023**, Ancona (IT)
Computing Highest Density Regions with Copulae
- 06/2023 Poster @ **MEMOTEF Research Days 2023**, Roma (IT)
Computing Highest Density Regions with Copulae
- 06/2023 Invited @ **ITACOSM 2023**, Arcavacata di Rende (IT)
Assessing the predictive accuracy of official-statistics registries: the Global MSE

- 05/2023 Seminar @ **Federico II U**, Napoli (IT)
Multinomial Thompson Sampling for Online Sequential Decision Making with Rating Scales
- 04/2023 Contributed @ **ICNA-STA 2023**, Prishtina (Kosovo)
Adaptive Experiments for Digital Education: Benefits and Statistical Challenges
- 02/2023 Seminar @ **BSU Together**, Cambridge U (online)
Enhancing the fight against doping: using copulae for multivariate testing analysis
- 2022
- 06/2022 Invited @ **IMS Annual Meeting 2022**, London (UK)
Multinomial Thompson Sampling for adaptive experiments with rating scales data
- 06/2022 Contributed @ **SIS 2022 Annual Meeting**, Caserta (IT)
Multinomial Thompson Sampling for adaptive experiments with rating scales data
- 06/2022 Invited @ **7th ICSPM 2022** (online)
Just-in-Time Adaptive Interventions to Guide Healthy Behavioral Changes
- 06/2022 Contributed @ **MEMOTEF Research Days 2022**, Roma (IT)
Enhancing the fight against doping: using copulas for multivariate testing analysis
- 05/2022 Contributed @ **AUEB SPORTS ANALYTICS WORKSHOP 2022**, AUEB, Athens (GR)
Enhancing the fight against doping: using copulas for multivariate testing analysis
- 05/2022 Seminar @ **Inserm-Singapore COLLAB: Next Generation Trials** (online)
Design-based Inference for Thompson Sampling
- 2021
- 11/2021 Invited @ **18th Armitage Workshop and Lecture**, Cambridge U (UK)
Design-based Inference in Response-Adaptive Randomization
- 11/2021 Invited @ **International Congress on Multiculturality** - Urbaniana U (IT)
Multiculturality and Interculturality: a qualitative analysis of focus groups
- 07/2021 Invited @ **Benoulli-IMS Young Research Meeting** (online)
Using Reinforcement Learning to Design Just-in-Time Adaptive Interventions
- 03/2021 Contributed @ **Stat.Edu21: New perspectives in Statistics Education** (online)
Adaptive Experiments for Digital Education: Benefits and Statistical Challenges
- 2017-20
- 12/2020 Seminar @ **Camplus College**, Roma (IT)
Reading the Numbers in Medicine: the Role of Statistics in Biomedical Studies
- 07/2019 Poster @ **University of Alberta**, Edmonton (CA)
Deep Learning to the Test: an Application to Traffic Data Streams
- 06/2018 Poster @ **Italian Statistical Society (SIS) Annual Meeting**, Palermo (IT)
Deep Learning to the Test: an Application to Traffic Data Streams
- 06/2018 Poster @ **Fifth Annual Workshop of the DSS PhD School**, Roma (IT)
Deep Learning to the Test: an Application to Traffic Data Streams
- 10/2017 Contributed @ **ISOQOL 2018**, Philadelphia (USA)
Modelling Strategies to Improve Estimates of Prognostic Factors Analyses with PROs
- '16-'18 Invited @ **EORTC**, Paris, Manchester, Bruxelles (EU)
An international field study for the reliability and validity of the EORTC-CML24

SERVICE TO PROFESSION

INTERVIEW	Susan Athey, Professore @ Stanford University , IMS Bulletin, 53(1), 2024
EDITOR	Editorial Board Member of the Young Statisticians Europe Project (2020+) Associate editor assistant: <i>Health and Quality of Life Outcomes</i> (2017-2018)
MEMBERSHIP	IMS, ACM, SIS, YoungSIS, ISCB, IBS Italy
CURATOR	Twitter page @WomenInStat; One World YoungStatS Webinars
REVIEWER	<i>Biometrics</i> ; <i>JASA</i> ; <i>SMMR</i> ; <i>SMAP</i> ; <i>Biometrical Journal</i> ; <i>NeuroCOMP</i> ; <i>AISTATS</i> ; <i>AMIA</i>

SCIENTIFIC EVENTS

COORDINATOR	MEMOTEF Research Days 2024
SCI COMMITTEE	MEMOTEF Research Days 2023; ICNA-STA 2023

ORGANIZER	EcoSta 2023 – Innovative design and analysis methods for optimizing healthcare IMS Annual Meeting 2022 – Statistical methods for innovative experimental designs OneWorld YoungStatS 2022 – Theory and Methods for Inference in MAB Problems
CHAIR	X Giornata del Dottorato in Scuola di Scienze Statistiche 2023 , DSS, Sapienza U ICNA-STA 2023 – Education Sciences GdR MEMOTEF 2023 – Networks and Graphs IMS 2022 – Inference Methods for Adaptively Collected Data ICNA-STA 2022 – Social and Humanity Sciences
<u>CO-SUPERVISION</u>	
2024 – current	Amy Armento, PhD Student @ University of Cambridge and @ Google
2021 – current	Xinru Wang, PhD Candidate @ National University of Singapore
2021 – current	Xueqing Liu, PhD Student @ National University of Singapore
2023	Sagnik Biswas, Internship @ Duke-NUS (Singapore) <i>Modeling non-stationarities in multi-armed bandit problems</i>
<u>SUPERVISION</u>	
2023	Cristofaro Indorato, MSc in FINASS @ Sapienza U (110 cum laude) <i>Scenari Futuri nel Metaverso: Predizione e sentiment analysis tramite RNN</i>
2023	Emilio Tarducci, MSc in FINASS @ Sapienza U (110 cum laude) <i>Thompson Sampling per decisioni ottime in finanza: scelta del modello e di portafogli</i>
2022	Thomas Slater, Summer Internship @ Cambridge U (UK) <i>Adaptive allocation under high dimensional contexts</i>

COMPUTER & LANGUAGE SKILLS

Computer:	R, R Studio, Python, \LaTeX , Microsoft Office, SAS, BUGS, WinBUGS, JAGS, Stan
R Packages	
countts	https://cran.r-project.org/web/packages/countts/
HDR2D	https://github.com/nina-DL/HDR2D
Languages:	Advanced: Italian, Romanian, English; Intermediate: Russian, French

PUBLICATIONS & PROCEEDINGS

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- 2024 Deliu, N., Williams, J. J. and Villar, S. S. *Finite-sample inference in response-adaptive designs: an application to Thompson sampling*. **Book of Short Papers SIS2024** (To Appear)
- 2024 Deliu, N., Williams, J. J. and Chakraborty, B., *Reinforcement Learning in Modern Biostatistics: Constructing Optimal Adaptive Interventions*. **International Statistical Review** (Accepted; To Appear). Arxiv preprint: <https://arxiv.org/abs/2203.02605>
- 2024 Deliu, N. and Chakraborty, B., *Artificial Intelligence-based Decision Support Systems for Precision and Digital Health*. In **Frontiers of Statistics and Data Science, IISA Series on Statistics and Data Science**, Springer (Accepted; To Appear)
- 2024 X. Wang, N. Deliu, Y. Narita, and B. Chakraborty, *Incorporating participants' welfare into sequential multiple assignment randomized trials*. **Biometrics** 80(1); <https://doi.org/10.1093/biometc/ujad004>
- 2024 Kumar, H. et al., *Using Adaptive Bandit Experiments to Increase and Investigate Engagement in Mental Health*. Proceedings of the **AAAI Annual Conference on Innovative Applications of Artificial Intelligence IAAI-24**, 38(21), 22906-22912; <https://doi.org/10.1609/aaai.v38i21.30328>
- 2024 Musabirov, I. et al., *Platform-based Adaptive Experimental Research in Education: Lessons Learned from Digital Learning Challenge*. Proceedings of **The International Conference on Learning Analytics & Knowledge LAK24** (To Appear; <https://www.solaresearch.org/events/lak/lak24/accepted-papers/>)

- 2023 Deliu, N. *Multinomial Thompson Sampling for Rating Scales and Prior Considerations for Calibrating Uncertainty*. **Statistical Methods and Applications** (Online first; <https://doi.org/10.1007/s10260-023-00732-y>)
- 2023 Deliu, N. *Reinforcement Learning for Sequential Decision-Making in Population Research. Quality and Quantity* (Online first; <https://doi.org/10.1007/s11135-023-01755-z>)
- 2023 Bhattacharjee, A., et al. *Informing Users about Data Imputation: Exploring the Design Space for Dealing With Non-Responses*. *Proceedings of the AAAI Conference on Human Computation and Crowdsourcing* 11(1), 14-26; <https://doi.org/10.1609/hcomp.v11i1.27544>
- 2023 Deliu, N., Liseo, B. *Computing Highest Density Regions with Copulae*. **Book of Short Papers SIS2023**, pages 1065–1070. Pearson ISBN 9788891935618
- 2023 Liu, X., Deliu, N., and Chakraborty, B., *Microrandomized trials: Developing just-in-time adaptive interventions for better public health*. **American Journal of Public Health**, 113(1):60–69; <https://doi.org/10.2105/ajph.2022.307150>
- 2023 Deliu, N., *Multiculturalism and Interculturalism: Qualitative Analysis of the Perspective of Focus Group Participants*. In *Education in Multiculturalism, Education to Interculturalism*. Urbaniana University Press ISBN 978-88-401-9061-7
- 2022 Deliu, N., *Multinomial Thompson Sampling for adaptive experiments with rating scales*. **Book of Short Papers SIS2022**, pages 1065–1070. Pearson ISBN 9788891932310
- 2022 Deliu, N. and Chakraborty, B., *Dynamic Treatments Regimes for Optimizing Healthcare*. In *The Elements of Joint Learning and Optimization in Operations Management*, pages 391–444. Springer; https://link.springer.com/chapter/10.1007/978-3-031-01926-5_15
- 2022 Chien, I., Deliu, N., Turner, R.E., Weller, A., Villar, S.S., Kilbertus, N. *Multi-disciplinary fairness considerations in machine learning for clinical trials*, *Proceedings of the ACM Conference on Fairness, Accountability, and Transparency (FACCT '22)*; <https://doi.org/10.1145/3531146.3533154>
- 2022 Figueroa, C. A., Deliu, N., Chakraborty, B. et al., *Daily Motivational Text-Messages to Promote Physical Activity in University Students: Results from a Micro-Randomized Trial*, **Annals of Behavioral Medicine** 56(2):212-218; <https://doi.org/10.1093/abm/kaab028>
- 2021 Figueroa, C. A., Aguilera, A., Chakraborty, B. et al., *Adaptive Learning Algorithms to Optimize Mobile Applications for Behavioral Health: Guidelines for Design Decisions*. **J Am Med Inform Assoc** 12;28(6):1225-1234; <https://doi.org/10.1093/jamia/ocab001>
- 2019 Cottone, F., Deliu, N., Collins, GS, et al. *Modeling strategies to improve parameter estimates in prognostic factors analyses with patient-reported outcomes in oncology*, **Qual Life Res**; <https://doi.org/10.1007/s11136-018-02097-2>
- 2019 Cottone, F., et al. *The prognostic value of patient-reported outcomes (PROs) for survival outcomes in cancer patients: A systematic review*, **JCO** 37 (15_suppl), e18223-e18223; https://ascopubs.org/doi/abs/10.1200/JCO.2019.37.15_suppl.e18223
- 2019 Sparano, F., et al. *Clinician-reported symptomatic adverse events in cancer trials: Are they concordant with patient-reported outcomes?*, **J Comp Eff Res** 8(5):279-288; <https://doi.org/10.2217/ce-2018-0092>
- 2018 Deliu N., et al. *Evaluating methodological quality of Prognostic models Including Patient-reported Health outcomes in oncology (EPIPHANY): a systematic review protocol*, **BMJ Open** 8(10):e025054; <http://dx.doi.org/10.1136/bmjopen-2018-025054>
- 2018 Deliu, N. and Brutti, P. *Deep Learning to the Test: an Application to Traffic Data Streams*, **Book of Short Papers SIS2018**, ISBN-9788891910233

2018 Ousmen A., Touraine, C., Deliu, N., Cottone, F., et al. *Distribution and anchor based methods to determine the minimally important difference on patient reported outcome questionnaires in oncology*, *HQLO* 16:228; <https://doi.org/10.1186/s12955-018-1055-z>

PREPRINTS AND WORKING PAPERS

Under Review (after minor revision) Deliu, N. and Liseo, B. *Alternative Approaches for Computing Highest-Density Regions*. Arxiv preprint: <https://arxiv.org/abs/2401.00245>

In Revision Liu, X., Deliu, N., Chakraborty, T., Bell, L., Chakraborty, B., *Thompson sampling for zero-inflated count outcomes with an application to the Drink Less mobile health study*. Arxiv preprint: <https://arxiv.org/abs/2311.14359>

Under Review Deliu, N. and Liseo, B. *A Multivariate Copula-based Hierarchical Framework for Doping Detection*. Arxiv preprint: <https://arxiv.org/abs/2404.12499>

Under Review Deliu, N. and Villar, S.S., *Finite-sample and asymptotic validity of a novel design-based test statistic for response-adaptive randomisation*

Under Review Liu, X., Deliu, N., Bell, L., Chakraborty, B., *A comparison of longitudinal models for analyzing contextual bandit collected count data in mobile health*

Under review Deliu, N. et al, *StratosPHere 2: A response-adaptive randomised placebo-controlled Phase II trial to evaluate hydroxychloroquine and phenylbutyrate in pulmonary arterial hypertension caused by mutations in BMPR2*. Preprint: <https://doi.org/10.21203/rs.3.rs-3392621/v1>

Preprint Li, T., Nogas, J., Song, H., Kumar, H., Durand, A., Rafferty, A., Deliu, N., Villar, S.S., Williams, J.J. *Algorithms for Adaptive Experiments that Trade-off Statistical Analysis with Reward: Adaptively Combining Uniform Random Assignment and Thompson Sampling*. Presented at the Workshop on Causal Sequential Decisions 2021, NeurIPS 2021. Arxiv preprint: <https://arxiv.org/abs/2112.08507>

Preprint Williams, J. J., Nogas, J., Deliu, N. et al., *Challenges in Statistical Analysis of Data Collected by a Bandit Algorithm: An Empirical Exploration in Applications to Adaptively Randomized Experiments*. Arxiv preprint: <https://arxiv.org/abs/2103.12198>

In Submission Deliu, N, Falorsi, PD, Falorsi, S., Chianella, D, Alleva, G. *Assessing the predictive accuracy of official-statistics registries: the Global Mean Squared Error*



June 11, 2024