Dr Elizaveta Semenova

https://www.elizaveta-semenova.com/
https://twitter.com/liza_p_semenova
elizaveta.p.semenova@gmail.com
elizavetasemenova

Research appointments

Mar 2024 **Lecturer in Biostatistics, Computational Epidemiology and Machine Learning**, Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London

Mar 2023 – Feb 2024 **Schmidt Futures AI 2050 Early Career Fellow**, Department of Computer Science, University of Oxford

- Introducing parameter inference capability into prior-encoding VAEs for fast MCMC inference
- Developing adaptive survey design approach allowing to increase efficiency of surveys, lower the cost of data collection and bias.

Mar 2022 – Feb 2023 **Postdoctoral Researcher in Computational Statistics and Machine Learning**, Department of Computer Science, University of Oxford

Oct 2022 – Feb 2023 **Junior Research Fellow**, Kellogg College, Oxford

2021 – 2022 **Postdoctoral Research Associate in Mathematics**, Department of Mathematics, Statistics Section, Imperial College London

- Developing machine learning tools for faster Bayesian inference and modelling of spatiotemporal data by leveraging deep generative models (VAEs)
- Performing applied epidemiology work to inform public policy as a response to the COVID-19 pandemic: (i) analysis of global genomic surveillance disparities; (ii) investigating paediatric disease severity

2019 – 2021 **PostDoc Fellow in Bayesian Machine Learning**, AstraZeneca, Cambridge, UK

- Developing a Bayesian neural network model for toxicity prediction to communicate uncertainty and prevent overfitting of biological data. Predicting drug toxicity by incorporating scientific knowledge into Bayesian ML models.
- Fitting flexible concentration-response curves of a novel drug modality using Gaussian Processes.
- Developing models of COVID-19 testing regimes to inform internal company's testing policy.
- Providing statistical consulting to experimental biologists for scientific hypothesis testing

Qualifications

2014 – 2019 **PhD in Epidemiology** (*summa cum laude*), Swiss Tropical and Public Health Institute, University of Basel, Switzerland: *"Bayesian modelling of large spatio-temporal disease surveillance and environmental data"*.

2003 – 2008 **Diploma in Mathematics** (first class honours), Moscow State University, Moscow, Russia

Previous work experience

2017 – 2018 **Board Member and Educator**, women++ (www.womenplusplus.ch), Zurich, Switzerland

- Ideated and organised the first female-friendly hackathon in Switzerland for over 100 participants. In 2019 it was included into the list of 80 most important diversity-related initiatives in Europe.
- Designed and tutored a series of programming workshops; organised tech- and career-related professional training, and networking events to foster entrepreneurship and leadership.

2016 – 2016 **R Developer**, remote

- Created R-scripts and web services enabling statistical analysis of clinical data.

2012 – 2014 **Teaching Assistant in Mathematics**, University of Basel, Switzerland

- Harmonic Analysis, Partial Differential Equations, Calculus (graduate and undergraduate levels)

2010 – 2011 **Actuarial Consultant**, PriceWaterhouse Coopers, Moscow, Russia

2008 – 2010 **Actuary**, Zurich Insurance Company, Russia / Germany /Switzerland

- Statistical data analysis, data mining, risk modelling, pricing tool development, due diligence

Grants and awards (total £ 280’000)

2023-2024	**Co-investigator** on Imperial Seed Funding grant for a two day workshop at AIMS-Rwanda “North-South-AIMS-Imperial: research-led teaching and mentoring in modern statistics and global health" (£9,992).
2023	**Recognition** and Reward from the Computer Science Department, Oxford (£ 200).
2023	**Sponsorship** from The Wellcome Trust (£10K) and Google ($1,5K) to support students from underrepresented backgrounds to participate in the ML & Global Health Workshop, ICLR, Rwanda.
2022	Schmidt Futures AI2050 Early Career Fellowship ($ 300’000).
2023	Nordic ProbAI’23 summer school, Travel grant to deliver a lecture (could not travel due to visa issues).
2023	SIAM Conference on Computational Science and Engineering, Travel grant to deliver a workshop (€ 500).
2022	The International Congress of Toxicology, Travel grant to deliver a lecture (£ 700).
2022	Nordic ProbAI’22 summer school, Travel grant to deliver a lecture (€ 800).
2022	UK-China collaborative workshop: AI for Climate, Environment and Sustainability, Travel grant (£ 500).
2021	Google Season of Docs (GSoD) bursary to contribute Julia documentation ($ 3000)
2020	AstraZeneca R&D, Postdoc of the Year award

Teaching, supervision and mentoring

- Course development
  - “Bayesian modelling and Probabilistic programming with examples from epidemiology", a 30h course for the “AI for Science" MSc programme at AIMS-SA
- Research Supervision
  - Co-supervising a DPhil on prior-encoding graph neural networks (2023-present, Oxford, Computer Science)
  - Co-supervised an MSc project “Improving the approximation accuracy of scalable MCMC parameter inference with Bayesian deep generative modelling" (2023, Oxford, Computer Science)
  - Co-supervised an MSc project “Enhancing VAE-learning on spatial priors using graph convolutional networks" (2022, Oxford, Computer Science)
  - Co-supervised an MSc project “Forecasting of Human Mobility Flows in the United States using Hilbert Space Gaussian Process approximations" (2022, Imperial College London, Statistics)
  - Supervised a PhD mini-project (3 months) “Exploring identifiability in Bayesian linear and cubic regression models" (2022, Imperial College London, Statistics).
  - Co-supervised an MSc project “Modelling the Number of Children who Lost Parents and Caregivers due to COVID-19-Associated Mortality in the 27 Federative Units in Brazil" (2022, ICL, Public Health)
- Lectures and hands-on workshops
  - Developing and teaching a 3-week course at African Institute for Mathematical Sciences (AIMS), Muizengerg, South Africa, on "Probabilistic modelling and programming for Epidemiology"; part of MSc "AI for Science" programme (2024, upcoming)
  - “Introduction to probabilistic thinking and programming" practical, Deep Learning Indaba, Ghana (Sept 2023)
  - “Bayesian inference" lecture, Deep Learning Indaba, Ghana (Sept 2023)
  - Teaching sub-modules of “Bayesian Modeling for Environmental Health Workshop: Concepts and Computational Tools for Spatial, Temporal, and Spatiotemporal Modeling relevant to Public Health", Columbia University (Aug 2023)
  - “Bayesian workflow", Nordic Probabilistic AI summer school, Trondheim, Norway (June 2023 [*])
  - “Bayesian Scientific Computing and Probabilistic Programming: inside and outside the “black box”", SIAM Computational Science and Engineering, Amsterdam, Netherlands. In collaboration with Daniela Calvetti, Erkki Somersalo (Case Western Reserve University) and Maria han Veiga (University of Michigan) (2023 [*])
  - “Mathematics and Statistics for Machine Learning", Deep Learning Indaba, Tunis, Tunisia (2022)
  - “Bayesian workflow", Nordic Probabilistic AI, Helsinki, Finland (2022)
  - “Bayesian modelling of spatial data", Cambridge University, guest lecture and mentorship round table (2022)
  - “Hands-on Bayesian Machine Learning: embracing uncertainty” (in Julia). Over 100 participants; the most popular workshop at the conference. Applied Machine Learning Days (AMLD), Lausanne, Switzerland (2020)
  - “Bayesian Inference with Python”, PyPharma conference, Basel (2019)

[*] Could not attend in person due to visa issues

  - “Machine Learning for news (using NLP): theory, applications and visualization in Python”, Lausanne (2018)
  - “Bayesian Statistics with R and Stan", R-Lausanne Meetup (2018)
  - Selected lectures in Bayesian modelling and Biostatistics to an MSc course: theory and hands-on practicals in R, BUGS and Stan. Groups of ∼20 people (2014-2019).
  - Weekly marking of problem sheets and discussion of solutions for two graduate courses: Harmonic Analysis and Partial Differential Equations, groups of ∼15 students (2012-2014).
  - Bi-weekly grading and in-person presentation of solutions in Calculus to mathematics, physics and informatics undergraduates, groups of ∼30 (2012-2014)

- Mentorship
  - Pastoral supervision of 7 MSc and PhD students in maths, computer science, machine learning (2022 - present)
  - AISTATS2022, mentoring PhD applicants (2022)
  - Mentorship round tables for undergradutes in maths and computer science, Cambridge University (2022)

Organisation, outreach, public engagement and admin

2024 Co-organiser of StanCon 2024
2023 Invited speaker at Rise Residential Summit
2023 Lead organiser of the ICLR First Workshop on "Machine Learning & Global Health", Kigali, Rwanda
2023 Co-organiser of symposium "Probabilistic methods in microbiome ecology", Kellogg College, Oxford
2023 Helped interviewing PhD candidates for the AIML research theme at the University of Oxford,
2022 Co-organiser of NeurIPS workshop "Gaussian Processes, Spatiotemporal Modeling, and Decision-making Systems", New Orleans, US
2022 Co-organiser of Gaussian Process seminar series, virtual
2022 Data Science Ambassador of the Faculty of Natural Sciences at Imperial College London, UK,
2020 Guest at the podcast "Learning Bayesian Statistics"; among the top popular episodes on the channel
2019 Organising committee of PyPharma conference
2019 Basel Computational Methods for Research Community, Meetup organiser, Basel, Switzerland
2018 Speaker at Women Techmakers Leads Summit Europe (Google), Madrid, Spain
2018 Co-founder of Switzerland’s first female-friendly hackathon Hack’n’Lead

Invited talks, lectures and courses

2024, Mar	Course at African Institute for Mathematical Sciences (AIMS), Muizengerg, South Africa (upcoming)
2024, Feb	AIMS, Rwanda (remote talk)
2024, Jan	University of Edinburgh, Statistics Seminar
2023, Nov	University of Bristol, Statistics Department
2023, Oct	Talk at Imperial College London, Statistics Seminar
2023, Oct	Talk at Oxford University, Biology Department
2023, Sept	Talk at the Royal Statistical Society Conference *
2023, Sept	Talk at Gaussian Process Summer School , Manchester
2023, Sept	Lecture and practical at Deep Learning Indaba, Ghana
2023, Aug 14	Lecturing at “Bayesian Modeling for Environmental Health Workshop", Columbia University, US
2023, Jun 29	Talk at MRC Centre for Global Infectious Disease Analysis, Imperial College London
2023, Jun 3-15	Talk at “Lifting Inference with Kernel Embeddings" (LIKE23), Bern, Switzerland
2023, Jun 15	Lecture at Nordic Probabilistic AI (ProbAI) summer school, Trondheim, Norway *
2023, Apr 25	Talk at “Probabilistic programming" workshop, Alan Turing Institute *
2023, Mar 01	Talk at "Variational inference, from theory to practice" Minisymposium of SIAM Conference on Computational Science and Engineering, Amsterdam
2022, Nov 18	Talk at Autonomous Intelligent Machines and Systems seminar, Oxford
2022, Oct 25	Talk "How can deep generative modelling help with spatial statistics?", Infectious Disease Epidemiology seminar series, Imperial College London
2022, Sep 18	Talk "Capturing uncertainty in toxicity profiling models", XVIth International Congress of Toxicology, Maastricht, Netherlands
2022, Aug 21	Lecture "Mathematics and Statistics for Machine Learning", Deep Learning Indaba , Tunis, Tunisia
2022, Aug 19	Talk at Uniq+, DeepMind social lunches in Oxford
2022, Aug 5	Talk "Encoding spatial priors with VAEs for geospatial modelling", 5th Workshop on Tractable Probabilistic Modeling at Unceritainty in Artificial Intelligence (UAI) conference, Eindhoven, Netherlands
2022, Jun 26	Talk at Oxford Computational Statistics and Machine Learning (OxCSML) seminar
2022, Jun 13	Lecture "Bayesian workflow", Nordic Probabilistic AI (ProbAI) summer school, Helsinki, Finland
2022, Apr 25	Lecture "Bayesian modelling of spatial data", Cambridge’s first machine learning research event for undergraduates, University of Cambridge, UK
2022, Feb 10	Talk "Encoding spatial priors with VAEs for geospatial modelling", *University of Lancaster, CHICAS seminar*, remote

Esteem indicators

- Reviewer for (i). ML/statistics journals "Journal of the Royal Statistical Society: Series A (JRSSA)", "Springer Nature Machine Learning", (ii). public health journals "PLOS Global Public Health", "Geospatial Health", "Parasite epidemiology and control", "Tropical medicine and international health"; (iii). PharML conference; (iv). "AI for Agent-Based Modelling" workshop ICLR’23
- Deep Learning Indaba (DLI) 2023 Programme Committee
- Quoted in a Science Magazine article "China is flying blind as pandemic rages" on China’s Covid surveillance plan
- Member of European Women in Mathematics (EWM), International Society for Bayesian Analysis (ISBA), American Society of Tropical Medicine and Hygiene (ASTMH)
- Poster jury member at Deep Learning Indaba (2022)
- Hackathons: invited jury member (Basel Hack), winner (Hack Zurich & Crack the Hack) (2017-2018)

Contributed talks and poster presentations

2023 **E. Semenova**, S. Mishra, S. Bhatt, S. Flaxman, H. J. Unwin "Spatial statistics with deep generative modelling: flexible and efficient disease mapping with MCMC and deep learning", *UAI 2023 workshop "Epistemic Uncertainty in Artificial Intelligence"*, Pittsburgh, USA

2023 **E. Semenova**, S. Mishra, S. Bhatt, S. Flaxman, H. J. Unwin "Spatial statistics with deep generative modelling: flexible and efficient disease mapping with MCMC and deep learning", *BayesComp 2023, Bayesian Inference of Epidemics*, Levi, Finland

2022 **E. Semenova**, S. Mishra, S. Bhatt, S. Flaxman, H. J. Unwin "Mapping malaria prevalence in Kenya by reconciling changes in administrative boundaries using MCMC and Deep Learning", *American Society of Tropical Medicine & Hygiene*, annual meeting (remote)

2021 L. Grinsztajn, **E. Semenova**, C. Margossian, J. Riou "Bayesian workflow for disease transmission modeling in Stan", *Berlin Bayesians Meetup*, (remote)

2020 **E. Semenova**, "Building an ordered logistic regression model for toxicity prediction" (talk), *PyMCon conference*, remote

2020 **E. Semenova**, A. Afzal, D. Williams, S. Lazic, "Bayesian Neural Networks for toxicity prediction" (talk), *Applied Machine Learning Days (AMLD) conference*, Lausanne

2019 **E. Semenova**, D. Williams, S. Lazic, "Predicting severity of drug-induced liver injury with uncertainty" (poster), *AwayDay conference*, University of Cambridge

2019 **E. Semenova**, D. Williams, S. Lazic, "A Bayesian multi-layered model to predict mechanisms, types, and severity of drug-induced liver injury" (poster), *StanCon-2019 conference*, Cambridge

2017 **E. Semenova**, P. Vounatsou, "Fitting large-scale Log-Gaussian Cox Process model with an efficient sampling algorithm" (poster), *46th SpeedUp Workshop on "Uncertainty Quantification and HPC"*, Bern

2016 **E. Semenova**, "Point Pattern Analysis for Malaria Surveillance" (talk), Malaria Modelling Group's seminar, Basel,

2016 **E. Semenova**, P. Vounatsou, "Early Warning Platform for Malaria Surveillance and Response" (talk), *Swiss Academy for development, Research Fair "Transcending the Silos to Prevent Crises"*, Bern

2014 **E. Semenova**, G. Crippa, "The Euler equation: stability and continuity in 2D" (talk), *Analysis seminar*, Geneva

Publications

My research interests include Bayesian inference, spatiotemporal statistics, deep generative modelling, epidemiology, drug discovery and mathematics. I have published 17 papers; in disciplines where order matters (not mathematics), I am first or co-first on 4 and corresponding author on 3 ($*$ denotes joint authorship and † denotes corresponding author).

Peer reviewed publications

1. S. Flaxman, C. Whittaker, **E. Semenova**, T. Rashid, R. Parks, A. Blenkinsop, H. J. T. Unwin, S. Mishra, S. Bhatt, D. Gurdasani, *et al.*, Assessment of COVID-19 as the Underlying Cause of Death Among Children and Young People Aged 0 to 19 Years in the US, *JAMA Network*, 2023.
2. A. Brito*, **E. Semenova***, G. Dudas*, G. Hassler, C. Kalinich, M. Kraemer, S. Hill, O. Pybus, C. Dye, S. Bhatt, *et al.*, Global disparities in SARS-CoV-2 genomic surveillance, *Nature Communications*, 2022.
3. A. Brizzi, C. Whittaker, L. M. Servo, I. Hawryluk, C. A. Prete Jr, W. M. de Souza, R. S. Aguiar, L. J. Araujo, L. S. Bastos, A. Blenkinsop, *et al.*, Spatial and temporal fluctuations in covid-19 fatality rates in brazilian hospitals, *Nature medicine*, **28**, (7), 1476–1485, 2022.
4. J. W. Firman, M. T. Cronin, P. H. Rowe, **E. Semenova**, and J. E. Doe, The use of Bayesian methodology in the development and validation of a tiered assessment approach towards prediction of rat acute oral toxicity, *Archives of toxicology*, 1–14, 2022.
5. **E. Semenova***,†, Y. Xu*, A. Howes, T. Rashid, S. Bhatt, S. Mishra, and S. Flaxman†, PriorVAE: encoding spatial priors with variational autoencoders for small-area estimation, *Journal of the Royal Society Interface*, **19**, (191), 20220094, 2022.
6. L. Grinsztajn, **E. Semenova**, C. C. Margossian, and J. Riou, Bayesian workflow for disease transmission modeling in Stan, *Statistics in Medicine*, 1–26, 2021.
7. L. H. Mervin, S. Johansson, **E. Semenova**, K. A. Giblin, and O. Engkvist, Uncertainty quantification in drug design, *Drug discovery today*, **26**, (2), 474–489, 2021.
8. S. Mishra, S. Mindermann, M. Sharma, C. Whittaker, T. A. Mellan, T. Wilton, D. Klapsa, R. Mate, M. Fritzsche, M. Zambon, J. Ahuja, A. Howes, X. Miscouridou, G. P. Nason, O. Ratmann, **E. Semenova**, G. Leech, J. F. Sandkühler, C. Rogers-Smith, M. Vollmer, H. J. T. Unwin, Y. Gal, M. Chand, A. Gandy, J. Martin, E. Volz, N. M. Ferguson, S. Bhatt, J. M. Brauner, S. Flaxman, and The COVID-19 Genomics UK (COG-UK) Consortium, Changing composition of SARS-CoV-2 lineages and rise of Delta variant in England, *EClinicalMedicine*, **39**, 101064, 2021.

9. L. Scott, N.-Y. Hsiao, S. Moyo, L. Singh, H. Tegally, G. Dor, P. Maes, O. G. Pybus, M. U. Kraemer, **E. Semenova**, *et al.*, Track Omicron's spread with molecular data, *Science*, **374**, (6574), 1454–1455, 2021.
10. **E. Semenova**†, M. L. Guerriero, B. Zhang, A. Hock, P. Hopcroft, G. Kadamur, A. M. Afzal, and S. E. Lazic, Flexible fitting of PROTAC concentration-response curves with changepoint Gaussian Processes, *SLAS Discovery*, **26**, (9), 1212–1224, 2021.
11. P. Velmisov, Y. A. Tamarova, and **E. Semenova**, Asymptotic equations of gas dynamics: Qualitative analysis, construction of solutions, and applications, *Journal of Mathematical Sciences*, **259**, (3), 309–325, 2021.
12. S. E. Lazic, **E. Semenova**, and D. P. Williams, Determining organ weight toxicity with Bayesian causal models: Improving on the analysis of relative organ weights, *Scientific reports*, **10**, (1), 1–12, 2020.
13. **E. Semenova**†, D. P. Williams, A. M. Afzal, and S. E. Lazic, A Bayesian neural network for toxicity prediction, *Computational Toxicology*, **16**, 2020.
14. D. P. Williams, S. E. Lazic, A. J. Foster, **E. Semenova**, and P. Morgan, Predicting drug-induced liver injury with Bayesian machine learning, *Chemical research in toxicology*, **33**, (1), 239–248, 2019.
15. G. Crippa, **E. Semenova**, and S. Spirito, Strong continuity for the 2d Euler equations, *Kinetic and Related Models*, (4), 685–689, 2018.
16. P. A. Velmisov, U. J. Mizher, and **E. P. Semenova**, Asymptotic study of nonlinear viscous gas flows, in *AIP Conference Proceedings*, AIP Publishing LLC, vol. 2048, 2018, pp.040012.
17. P. A. Velmisov, A. V. Ankilov, and **E. P. Semenova**, Mathematical modeling of aeroelastic systems, in *AIP Conference Proceedings*, AIP Publishing LLC, vol. 1910, 2017, pp.040010.
18. P. A. Velmisov, A. V. Ankilov, and **E. P. Semenova**, Dynamic stability of deformable elements of one class of aeroelastic constructions, in *AIP Conference Proceedings*, AIP Publishing LLC, vol. 1789, 2016, pp.020021.

Pre-prints

1. J. Bouman, A. Hauser, S. L. Grimm, M. Wohlfender, S. Bhatt, **E. Semenova**, A. Gelman, C. L. Althaus, and J. Riou, Bayesian workflow for time-varying transmission in stratified compartmental infectious disease transmission models, *medRxiv*, 2023–10, 2023.
2. **E. Semenova**, S. Mishra, S. Bhatt, S. Flaxman, and H. J. T. Unwin, *Deep learning and MCMC with aggVAE for shifting administrative boundaries: mapping malaria prevalence in Kenya*, 2023. arXiv: `2305.19779 [stat.ML]`.
3. **E. Semenova**, P. Verma, M. Cairney-Leeming, A. Solin, S. Bhatt, and S. Flaxman, *PriorCVAE: scalable MCMC parameter inference with Bayesian deep generative modelling*, 2023. arXiv: `2304.04307 [stat.ML]`.

Under review or revision

1. S. Göpel, D. Adingupu, J. Wang, **E. Semenova**, M. Behrendt, P. Konings, R. Löfmark, C. Ahlström, A. Jönsson-Rylander, S. Gopaul, R. Esterline, L.-M. Gan, and R.-P. Xiao, SGLT2 inhibition improves coronary flow velocity reserve and contractility: Role of glucagon signaling, *Communication Medicine - Nature (minor revisions)*,
2. **E. Semenova**, S. Dalmini, and P. Vounatsou, Modelling Log-Gaussian Cox Processes on fine spatio-temporal scale, *Spatial and Spatio-temporal epidemiology (under revision)*,
3. T. Strain, S. Flaxman, R. Guthold, **E. Semenova**, M. Cowan, L. Riley, F. Bull, and G. Stevens, National, regional and global trends in insufficient physical activity from 2000 to 2022: A pooled analysis of 503 surveys with 5.7 million participants, *Lancet Global Public Health (under review)*,
4. T. Rawson, W. Hinsley, R. Sonabend, **E. Semenova**, A. Cori, and N. Ferguson, The impact of health inequity on regional variation of COVID-19 infection in England, *Nature Communications (under review)*, 2023.

Book chapters

1. S. K. Ashenden, A. Bartosik, P.-M. Agapow, and **E. Semenova**, Introduction to artificial intelligence and machine learning, *The Era of Artificial Intelligence, Machine Learning, and Data Science in the Pharmaceutical Industry*, 15–26, 2021.

Technical writing and Open Source

1. L. Badillo, **E. Semenova**, and L. Kilpatrick, *Julia Ecosystem Contributor's Guide*, 2021.

Languages: general programming, probabilistic programming and natural

General and probabilistic programming	R, Python, Julia; Stan, PyMC3, Numpyro, Turing.jl
Deep learning frameworks	PyTorch, JAX
Languages	Russian (native), English & German (working proficiency), Italian & French (beginner)