James Holehouse

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My Website
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Biography

I'm a postdoc at the Santa Fe Institute and completed my PhD in Mathematical Biology at the University of Edinburgh, specializing in the application of stochastic methods to study gene regulatory networks. I obtained a first-class honors degree in Theoretical Physics (MPhys) from the University of Edinburgh. I am interested in complexity and non-equilibrium statistical physics, particularly: **gene expression, enzyme kinetics, cross-situational learning and complexity economics/econophysics**. Most of my work has been interested in **constructing stochastic models**, **model reduction** or **time-dependent** analytic solutions of non-equilibrium problems.

Employment History

October 2022 – Present
Postdoc at the Santa Fe Institute.
Postdoc, supervised by Sidney Redner, Chris Kempes, Geoffrey West, Vicky Chuqaio Yang and Hyejin Youn (Northwestern University). Research topics are a mix of studies on principles of regulatory networks, but additionally on problems in non-equilibrium statistical physics. I organised 72 Hours of Science for the year 2023 on the topic "The Science of the Science of Science".

May 2021 – October 2021
Economic Modelling Intern at Cambridge Econometrics.
An industrial internship in complexity economics alongside Hector Pollitt.

Feb 2021 – Feb 2022
Tutor at MyTutor.
I tutor Maths and Physics at GCSE and A-level to school students.

Sept 2019 – June 2021
Teaching Assistant at the University of Edinburgh.
I taught Python programming to 1st year Biology students.

June 2017 – Aug 2017
NERC Summer Researcher at the University of Edinburgh.
A climate science summer internship supervised by Simon Tett, answering the question: "Has climate change affected the risk of summer anticyclones in the UK?"

Education

2018 – 2022
PhD, the University of Edinburgh in *Mathematical Biology*.
Studying stochastic models of gene expression under Prof. Ramon Grima, co-supervised by Prof. Meriem El Karoui.

2021
TensorFlow Certificates in *Coursera*.
Achieved 99% in courses on *Introduction to TensorFlow for Artificial Intelligence, Machine Learning, and Deep Learning* and *Convolutional Neural Networks in TensorFlow*.

Education (continued)

2020 – 2021 **Centre for Open Learning, the University of Edinburgh** *Introduction to Philosophy*.
I completed a night-school Philosophy course during my Ph.D. studies, achieving an overall mark of 67%. My assignments focused on the applications of Descartes method of doubt, Camus' conclusions on the story of Sisyphus, and Gilbert Ryle's criticism of Cartesian dualism.

2014 – 2018 **MPhys, the University of Edinburgh** in *Theoretical Physics*.
I achieved a First Class Honours degree (1:1), with 78% in my Masters project (studying under Prof. Richard Blythe) and 76% overall degree mark. My course choices were tailored to mathematical and statistical physics modules, including advanced statistical physics (72%), quantum theory (84%) and Fourier analysis and statistics (87%).

2012 – 2014 **A-Levels, Scarborough Sixth Form College**.
Obtained A*A*A in Mathematics, Physics and Chemistry respectively, and AS-Levels AA in Further Mathematics and Biology.

Seminars and Invited Talks

2023 **Workshop talk** at *The Santa Fe Institute*.
A unified mechanistic model of diversity in cities, cells and companies.

2022 **Seminar** at *Cambridge Econometrics*.
Stochastic methods for binary decision models.

Seminar at *Scuola Superiore Sant'Anna*.
Stochastic methods for binary decision models.

Invited talk at *The Santa Fe Institute*.
Time-dependent solutions to master equations in chemical kinetics and opinion formation.

2021 **Seminar** at *The University of St. Andrews*.
Stochastic time-dependent enzyme kinetics: Closed-form solution and transient bimodality.

2019 **Invited talk** at *The University of Edinburgh*.
Using moment-based maximum likelihood inference to infer parameters from experimental data.

Mentoring

2023 **Anish Pandya (The University of Texas at Austin)** at *The Santa Fe Institute*.
Volume Dependence in Stochastic Gene Expression.

Nathan Hasegawa (Harvey Mudd College) at *The Santa Fe Institute*.
Island Growth Models with Preferential Attachment.

Grants

2020 **Scottish Mathematical Biology Forum (SMBF) 2020 Research Collaboration Prize** for £500 alongside Jochen Kursawe of the University of St. Andrews.
The physical meaning and application of Hill functions in gene regulatory networks.

Research Publications

Articles

1 **Holehouse, J.** (2023). Recurrence and eigenfunction methods for non-trivial models of discrete binary choice. *Entropy*, *25*(7), 996.

2 **Holehouse, J.**, & Redner, S. (2023). First-passage on disordered intervals. *arXiv preprint arXiv:2307.08879*. Submitted.

3 Weidemann, D. E., **Holehouse, J.**, Singh, A., Grima, R., & Hauf, S. (2023). The minimal intrinsic stochasticity of constitutively expressed eukaryotic genes is sub-poissonian. *Science Advances*, *9*(32), eadh5138.

4 **Holehouse, J.**, & Moran, J. (2022). Exact time-dependent dynamics of discrete binary choice models. *Journal of Physics: Complexity*. **Corresponding author paper**.

5 **Holehouse, J.**, & Pollitt, H. (2022). Non-equilibrium time-dependent solution to discrete choice with social interactions. *PLOS ONE*. **Corresponding author paper**.

6 Braichenko, S., **Holehouse, J.**, & Grima, R. (2021). Distinguishing between models of mammalian gene expression: Telegraph-like models versus mechanistic models. *Journal of the Royal Society Interface*. **Joint first author publication**.

7 **Holehouse, J.**, Cao, Z., & Grima, R. (2020). Stochastic modeling of autoregulatory genetic feedback loops: A review and comparative study. *Biophysical journal*, *118*(7), 1517–1525.

8 **Holehouse, J.**, Gupta, A., & Grima, R. (2020). Steady-state fluctuations of a genetic feedback loop with fluctuating rate parameters using the unified colored noise approximation. *Journal of Physics A: Mathematical and Theoretical*, *53*(40), 405601.

9 **Holehouse, J.**, Sukys, A., & Grima, R. (2020). Stochastic time-dependent enzyme kinetics: Closed-form solution and transient bimodality. *The Journal of Chemical Physics*, *153*(16), 164113.

10 **Holehouse, J.**, & Grima, R. (2019). Revisiting the reduction of stochastic models of genetic feedback loops with fast promoter switching. *Biophysical journal*, *117*(7), 1311–1330.

11 **Holehouse, J.**, & Blythe, R. A. (2018). Cross-situational learning of large lexicons with finite memory. See pre-print at `https://arxiv.org/pdf/1809.11047.pdf`.

Educational Resources

1 **Holehouse, J.**, & Cameron MBE, B. (2017). Meteorological visibility observations: A user's guide. `https://www.tes.com/teaching-resource/meteorological-visibility-observations-a-user-s-guide-11694814?theme=0`. Accessed: 22/09/2021, Published in *Times Educational Supplement* (TES).

Skills

Languages — Native English speaker, basic Italian and BSL language skills.

Coding — Julia, Python, Mathematica, LaTeX, TensorFlow (basic).

Misc. — Stochastic modelling, non-equilibrium statistical mechanics, master equations, teaching and organising group social events.

Miscellaneous Experience

Awards and Achievements

2012 — **Gold Award**, The Duke of Edinburgh's Award.

2020–present — **Reviewer** for Mathematical Biosciences.

2021–present — **Reviewer** for PLoS One.

Reviewer for Physical Review E.

2023–present — **Reviewer** for Physical Review Letters.

Reviewer for Biophysical Journal.

Miscellaneous Experience (continued)

2022 **Winner of the Reinhart Heinrich award from the European Society for Mathematical Biology 2022.**

Certification

2014 **Sign Language Level 1 Certification**. Awarded by The Institute of British Sign Language.

References

Available on Request