

James Holehouse

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🌐 My Website

🐙 GitHub

🎓 Scholar

🌐 LinkedIn



Biography

- I'm a postdoctoral researcher at the Santa Fe Institute and previously was a PhD candidate in Mathematical Biology at the University of Edinburgh, specialising in the application of stochastic methods to study gene regulatory networks. I obtained a first class honours degree in Theoretical Physics (MPhys) from the University of Edinburgh. I have a wide-range of interests all of which are related to complexity or non-equilibrium statistical physics, including: **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

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|-------------------------|--|
| October 2022 – Present | ■ Postdoctoral researcher at the Santa Fe Institute.
Postdoctoral research position, primarily supervised by Sidney Redner, but additionally by Chris Kempes, Geoffrey West 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.
During my Ph.D. I undertook a 4-month industrial internship in economic modelling. This internship allowed me to apply the stochastic modelling toolkit I've developed to economic systems, with a particular interest in complexity economics. This culminated in the writing of an academic paper—my first as corresponding author. |
| Feb 2021 – Feb 2022 | ■ Tutor at MyTutor.
I tutor Maths and Physics at GCSE and A-level to school students of varying skill level. |
| Sept 2019 – June 2021 | ■ Teaching Assistant at the University of Edinburgh.
I teach Python programming to 1st year biology students; they begin with the very basics and by the end of the course take part in short data science projects employing self-made functions, classes and Python packages (e.g., pandas, seaborn, matplotlib). |
| June 2017 – Aug 2017 | ■ NERC Summer Researcher at the University of Edinburgh.
I completed a climate science summer internship supervised by Prof. Simon Tett. In this project I attempted to answer the question: "Has climate change affected the risk of summer anticyclones in the UK?" The technical aspect of this project involved working with and simulating high-resolution climate data on NERC's JASMIN supercomputer. |

Employment History (continued)

June 2016 – June 2017

■ **Hostel Worker at Argyle Backpackers, Edinburgh.**

A part-time job to help fund my studies. My main responsibilities included: checking in guests, organising the booking system, changing beds, cleaning rooms and providing advice on things to do and see in Edinburgh.

2008 – 2012

■ **Cook at The Old Forge, Bridlington.**

A part-time job on weekends and after school. I was taught how to cook all items on the day menu and did starters and desserts on the evening shift.

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. Initially, I worked mainly on models of genetic autoregulation looking at (1) the accuracy of the Hill function approximation, (2) comparisons of the analytical methods used to study autoregulation and (3) how to effectively incorporate more complex elements of gene expression via extrinsic noise. Current projects have been more varied, and I've investigated the accuracy of model reduction using the telegraph model and exact time-dependent solutions to the Michaelis-Menten enzyme reaction.

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

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*.

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. I also achieved the British Sign Language level 1 award from The Institute of British Sign Language, and Gold in the *Duke of Edinburgh's Award*.

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.

Seminars and Invited Talks (continued)

- 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.

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 Weidemann, D. E., **Holehouse, J.**, Singh, A., Grima, R., & Hauf, S. (2023). The minimal intrinsic stochasticity of constitutively expressed eukaryotic genes is sub-poissonian. (Accepted in Science Advances). See pre-print at <https://www.biorxiv.org/content/10.1101/2023.03.06.531283v2.abstract>.
- 3 **Holehouse, J.**, & Moran, J. (2022). Exact time-dependent dynamics of discrete binary choice models. *Journal of Physics: Complexity*. **Corresponding author paper.**
- 4 **Holehouse, J.**, & Pollitt, H. (2022). Non-equilibrium time-dependent solution to discrete choice with social interactions. *PLOS ONE*. **Corresponding author paper.**
- 5 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.**
- 6 **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.
- 7 **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.
- 8 **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.
- 9 **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.
- 10 **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.
- 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