

# DENIS PATTERSON



High Meadows Environmental Institute,  
Princeton University,  
Princeton, New Jersey

✉ denispatterson@princeton.edu  
🌐 denispatterson.com

## Research Interests

**Applied Analysis** Functional differential equations, stochastic processes, dynamical systems

**Mathematical Biology** Ecology (vegetation models), neuroscience/development (cell fate models)

## Academic Career

- Nov. 2020–present      **Postdoctoral Research Associate**, Princeton University  
High Meadows Environmental Institute  
Mentor: Prof. Simon A. Levin
- July 2018–Oct. 2020      **Postdoctoral Research Associate**, Brandeis University  
Department of Mathematics  
Mentor: Prof. Jonathan D. Touboul
- May 2017–May 2018      **Assistant Professor**, Dublin City University  
School of Mathematical Sciences
- Oct. 2013–Apr. 2018      **PhD in Applied Mathematics**, Dublin City University  
Thesis: *Asymptotic Growth in Nonlinear Stochastic and Deterministic  
Functional Differential Equations*  
Advisor: Prof. John A. D. Appleby
- 2009–2013      **BSc in Actuarial Mathematics**, Dublin City University  
First class honours – graduated first in class

## Publications

† alphabetical authorship, \* joint first author

### Journal Articles

- [J11] J. Feng\*, W. H. Hsu\*, **D. D. Patterson**, C. S. Tseng, Z. H. Zhuang, H. W. Hsin, Y.T. Huang, A. Faedo, J. L. Rubenstein, J. D. Touboul and S.J. Chou, *COUP-TFI specifies the medial entorhinal cortex identity and induces differential cell adhesion to determine the integrity of its boundary with neocortex*, Science Advances (2021), accepted.
- [J10] L. Xu, **D. D. Patterson**, A. C. Staver, S. A. Levin, J. Wang, *Unifying deterministic and stochastic ecological dynamics via a landscape-flux approach*, Proceedings of the National Academy of Sciences (2021), accepted.
- [J9] J. A. D. Appleby and **D. D. Patterson**<sup>†</sup>, *Growth and fluctuation in perturbed nonlinear Volterra equations*, Applied Mathematics and Computation (2021), Vol. 396, 125938.
- [J8] **D. D. Patterson**, S. A. Levin, A. C. Staver, J. D. Touboul, *Probabilistic foundations of spatial mean-field models in ecology and applications*, SIAM Journal on Applied Dynamical Systems, Vol. 19, No. 4 (2020), 2682–2719.
- [J7] J. A. D. Appleby and **D. D. Patterson**<sup>†</sup>, *Blow-up and superexponential growth in superlinear Volterra equations*, Discrete & Continuous Dynamical Systems Series A, Vol. 38, No. 8 (2018), 3993–4017.

- [J6] J. A. D. Appleby and **D. D. Patterson**<sup>†</sup>, *Growth rates of sublinear functional and Volterra differential equations*, SIAM Journal on Mathematical Analysis, Vol. 50, No. 2 (2018), 2086–2110.
- [J5] J. A. D. Appleby and **D. D. Patterson**<sup>†</sup>, *Memory dependent growth in sublinear Volterra differential equations*, Journal of Integral Equations and Applications, Vol. 29, No. 4 (2017), 531–584.
- [J4] J. A. D. Appleby and **D. D. Patterson**<sup>†</sup>, *Large fluctuations and growth rates of linear Volterra summation equations*, Journal of Difference Equations and Applications, Vol. 23, No. 6 (2017), 1047–1080.
- [J3] J. A. D. Appleby and **D. D. Patterson**<sup>†</sup>, *Growth rates of solutions of superlinear ordinary differential equations*, Applied Mathematics Letters, Vol. 71 (2017), 30–37.
- [J2] J. A. D. Appleby and **D. D. Patterson**<sup>†</sup>, *Hartman–Wintner growth results for sublinear functional differential equations*, Electronic Journal of Differential Equations, Vol. 2017, No. 21 (2017), 1–45.
- [J1] J. A. D. Appleby and **D. D. Patterson**<sup>†</sup>, *On the admissibility of unboundedness properties of forced deterministic and stochastic sublinear Volterra summation equations*, Electronic Journal of Qualitative Theory of Differential Equations, No. 63 (2016), 1–44.

### Conference Papers

- [C3] J. A. D. Appleby and **D. D. Patterson**<sup>†</sup>, *Classification of convergence rates of solutions of perturbed ordinary differential equations with regularly varying nonlinearity*, Electronic Journal of Qualitative Theory of Differential Equations, Proceedings of the 10th Colloquium on the Qualitative Theory of Differential Equations, No. 3 (2016), 1–38.
- [C2] J. A. D. Appleby and **D. D. Patterson**<sup>†</sup>, *Subexponential growth rates in functional differential equations*, Discrete and Continuous Dynamical Systems Supplement (2015), 56–65.
- [C1] J. A. D. Appleby and **D. D. Patterson**<sup>†</sup>, *On necessary and sufficient conditions for preserving convergence rates to equilibrium in deterministically and stochastically perturbed differential equations with regularly varying nonlinearity*, Recent Advances in Delay Differential and Difference Equations, Springer Proceedings in Mathematics & Statistics 94 (2014), 1–85.

### Academic Honours & Awards

2017	<b>Outstanding Graduate Researcher Award</b> , Dublin City University
2013–2017	<b>Government of Ireland Postgraduate Scholarship</b> , Irish Research Council
2013	<b>Student Actuary Prize</b> , Society of Actuaries in Ireland
2012	<b>Hamilton Award for Mathematics</b> , Royal Irish Academy

### Academic Talks

\* postponed or canceled due to the Covid-19 pandemic

June 2021	<b>Society for Mathematical Biology Annual Meeting</b> , online
May 2021	<b>SIAM Conference on Applications of Dynamical Systems</b> , online
Apr. 2021	<b>Fourth Northeast Regional Conference on Complex Systems</b> , online
Mar. 2021	<b>Theoretical Ecology Lab Tea</b> , Princeton University, USA
Aug. 2020	<b>Swartz Foundation Meeting</b> , Seattle, USA* (invited)
Mar. 2020	<b>SIAM Life Sciences Conference</b> , California, USA*
Mar. 2020	<b>SIAM Mathematics of Planet Earth</b> , California, USA*
Mar. 2020	<b>AMS Eastern Sectional Meeting</b> , Tufts University, USA* (invited)

Oct. 2019	<b>International Conference on Mathematical Modeling and Analysis of Populations in Biological Systems (ICMA) VII</b> , Arizona State University, USA
Sep. 2019	<b>Dynamical Systems Seminar</b> , Boston University, USA (invited)
May. 2019	<b>SIAM Conference on Applications of Dynamical Systems</b> , Snowbird, Utah, USA
Apr. 2019	<b>Mathematics and Statistics Seminar</b> , University of Limerick, Ireland (invited)
Mar. 2019	<b>Mathematics Everytopic Seminar</b> , Brandeis University, USA (invited)
Nov. 2018	<b>Mathematical Biology Seminar</b> , Brandeis University, USA
July 2017	<b>Equadiff 2017</b> , Slovak University of Technology in Bratislava, Slovakia
May 2017	<b>SIAM UK and Ireland Student Chapter Conference</b> , National University of Ireland Galway (Best Talk Prize)
Apr. 2017	<b>British Applied Mathematics Colloquium</b> , University of Surrey, UK
Mar. 2017	<b>Mathematics and Statistics Seminar</b> , University of Limerick, Ireland (invited)
July 2016	<b>11th AIMS Conference on Dynamical Systems, Differential Equations and Applications</b> , Orlando, Florida, USA
July 2015	<b>International Conference on Difference Equations and Applications 2015</b> , Bialystok University of Technology, Poland
July 2015	<b>10th Colloquium on the Qualitative Theory of Differential Equations</b> , Bolyai Institute, University of Szeged, Hungary
Dec. 2014	<b>Irish SIAM Student Chapter Conference</b> , National University of Ireland Galway
July 2014	<b>10th AIMS Conference on Dynamical Systems, Differential Equations and Applications</b> , Universidad Autonoma de Madrid, Spain (invited)

## Teaching Experience

### Courses taught

Summer 2020	Differential Equations, Brandeis University (fully online)
Fall 2019	Probability, Brandeis University
Spring 2019	Multivariate Calculus, Brandeis University
Winter 2017	Simulation for Finance (graduate course), Dublin City University <i>Theory and simulation of stochastic processes with financial applications</i>

### Undergraduate Research Projects supervised

Fall 2020	Jingman Li & Yuning Liu (Applied Math, Brandeis), “Network epidemic models”
Spring 2020	Hange Zhu (Applied Math, Brandeis), “Pattern formation in heterogeneous domains”
Summer 2019	Hanyu Song (Applied Math, Brandeis), “Mathematical models of somitogenesis”

## Programming/Software

<b>General</b>	C++, Python, R, Hive, SQL, VBA
<b>Math specific</b>	MATLAB, Mathematica, XPP/Auto, Matcont, FreeFEM++, GeoGebra, L <sup>A</sup> T <sub>E</sub> X

## Professional Activities & Affiliations

### Recent Workshops/Short Courses

- Selected participant in the AMS Mathematical Research Community “Dynamics of Infectious Diseases” (2020-2021)
- AMS short course on Mathematical and Computational Methods for Complex Social Systems (Jan. 2021)
- Banff workshop on the Mathematics of Human Environmental Systems (Jan. 2021)
- Hausdorff School on Diffusive Systems: Pattern Formation, Bifurcations, and Biological Applications (Apr. 2021)

### Service

- Reviewer for:
  - *Applied Mathematics and Computation*,
  - *Bulletin of Mathematical Biology*,
  - *Chaos: An Interdisciplinary Journal of Nonlinear Science*,
  - *Electronic Journal of the Qualitative Theory of Differential Equations*,
  - *Journal of Difference Equations and Applications*,
  - *Mathematical Biosciences*
- Co-organized the minisymposium “Stochastic Networks in Neuroscience and Ecology” at the SIAM Conference on Applications of Dynamical Systems (DS21)
- Organized the Brandeis Mathematical Biology Seminar series (2018–2019)
- Organized the DCU Mathematical Sciences Postgraduate Seminar series (2014–2017)

### Outreach

- Speaker for the “MRSEC Pizza Talks” science outreach program at Waltham High School (2020)
- Judge for SCUDEM V 2020 (high school/undergraduate mathematical modeling competition)
- University coordinator for the BITE/DCU Voluntary Math Tuition programme 2017/2018 (math outreach to disadvantaged schools to promote university access through tutoring and mentorship)
- DCU Access Service tutor 2015/2016 (academic support for disadvantaged university students)

### Professional Memberships

- Member of the Society for Industrial and Applied Mathematics (SIAM)
- Member of the Society for Mathematical Biology (SMB)
- Member of the International Society of Difference Equations (ISDE)
- Member of the American Association for the Advancement of Science (AAAS)