Gordon McDonald

data science | statistics | physics | mathematics | chemistry | teaching

I am a data scientist, physicist and teacher, working at the Sydney Informatics Hub, at the University of Sydney. I have extensive academic publication experience, simulation and computational data analysis experience, and a passion for informative data visualization techniques, which I have developed developed during 7 years of cutting-edge physics research and two years of project based statistical and data science consulting. I have taught university level physics and data analysis courses in Australia and Indonesia, as well as tutoring students in Statistics, Mathematics, Physics and Chemistry. My comunication abilities have been demonstrated while presenting my research at other universities and conferences in Australia, Indonesia, the US, and Europe; and I have co-authored 18 peer-reviewed papers in academic journals, as well as writing my honours and doctoral theses. I am experienced in working in a small team environment using agile management techniques; I have supervised two honours students and assisted in training three other PhD students, and have assisted with project management in my role at the University of Sydney.

experience

2016-Now	**Sydney Informatics Hub / Centre for Translational Data Science**	The University of Sydney

Data Science Research Engineer

Since working as a data scientist at the Sydney Informatics Hub, I have been applying frequentist, machine learning and Bayesian statistical techniques to:

Health
· An analysis of the relative risk of discharge against medical advice within the Sydney Children's Hospital Network over five years of historical admissions records and 250k admissions, which I presented at the Health Data Analytics conference in Brisbane, October 2017.
· Clinical studies at the Woolcock Institute into sleep disorders such as insomnia and how they can be monitored with actigraphy measurements (i.e. a fitness wristwatch).

Science
· Creating a software tool to streamline the process of analyzing metabolites through High Pressure Liquid Chromatography Mass Spectroscopy (HPLC-MS) at the Charles Perkins Centre.
· Developing a software tool to enable researchers to calculate chemical concentrations and kinetics in complex biological reactions involved in cell differentiation in developing spinal cords.

Education
· Financial modelling for the NSW Department of Industry's Smart and Skilled program for Vocational education and training, which allocates more than $600 million a year in subsidies.

Social Science
· Correlating election results for the 2016 US presidential election and the 2016 UK Brexit election with demographics of each electoral region.
· Analysing crime data across NSW looking for spatiotemporal patterns which can be exploited to improve policing efficiency.

Since partly taking on the role of the university's statistical consulting service, I have also been providing statistical assistance to researchers across the university including meta-analyses, survey analysis and statistical methods.

I designed and built the Sydney Informatics Hub website at https://informatics.sydney.edu.au

2015	**Quantum Sensors and Atom Laser Group**	Australian National University

Postdoctoral Researcher

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education

2010–2015	**PhD** in Experimental Quantum Physics	Australian National University

Thesis: *"Cold Atom Interferometry in Optical Potentials"*
Worked in a small team to develop and prototype the next generation of quantum sensors for fundamental science and industrial applications.

2009	**First class Honours with University Medal** in Physics,	Australian National University

Thesis: *"Detecting Atomic Shot Noise On Ultra-cold Atom Clouds"*

2006–2008	**Bachelor** of Science	Australian National University

Majoring in Physics and Chemistry, minor in Mathematics. High Distinction average of 90% (Grade point average of 6.87 out of 7).

teaching experience

2018	**Data Carpentry R Ecology course**	ResBaz2018 @ Macquarie University

Teaching a 2-day workshops on basic data analysis and reproducible research

2017	**Sydney Machine Learning**	Amazon Web Services, Sydney

Teaching basic data science skills in Python in a course following the CS109 syllabus from Harvard.

2017	**Certified Software Carpentry Instructor**	Software Carpentry

Teaching workshops on basic data analysis and reproducible research

2017	**Introduction to data analysis in R**	Brain and Mind Centre, University of Sydney

Course Coordinator

2013	**International Engineering Program**	University of Indonesia

Guest Lecturer in Electromagnetism

2012–2015	**ANU Dance and Salsabor Dance Studio**	Canberra, Australia and Washington DC, USA

Dance Teacher

2010–2014	**Advanced Physics Tutor**	Australian National University

I tutored first-year Foundations of Physics, third-year Advanced Theoretical Physics and fourth-year Honours Electromagnetism

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selected awards

2014	**Vice Chancellor's Award for Outstanding Contribution to Student Learning**	ANU
2014	**Editor's choice for a publication in Europhysics Letters**	Europhysics Letters
2009	**University Medal**	ANU

selected publications

My work at the University of Sydney has resulted in a co-authorship on one published paper, with four more in preparation. I gave a talk at the Health Data Analytics conference in Brisbane in October 2017 on our work on discharge against medical advice in the Sydney Children's Hospital Network. My doctoral research resulted in 18 scientific publications in peer-reviewed journals from 2011 to 2017 (garnering over 600 citations so far); as well as 12 presentations delivered around the world, in addition to my doctoral thesis, all of which are available upon request. My honours thesis is also available. Seven selected publications are highlighted below.

2018 — Disparate binding kinetics by an intrinsically disordered domain enables temporal regulation of transcriptional complex formation
Proceedings of the National Academy of Sciences
Chemical reaction rate in gene transcription in motor neurones is affected by domains of protein which lack a well-defined 3D structure. This in turn affects cell differentiation.
Proceedings of the National Academy of Sciences **115** (18) 4643-4648 (2018)

2017 — Observation of a modulational instability in Bose-Einstein condensates
Physical Review A
We compare theory to experiment in the breakup of an attractive quantum gas in an optical waveguide. This is analogous to water on a surface breaking up and forming droplets.
Phys. Rev. A **96** 041601(R) (2017)

2016 — Simultaneous Precision Gravimetry and Magnetic Gradiometry with a Bose-Einstein Condensate: A High Precision, Quantum Sensor
Physical Review Letters
We measure local gravity to a part per billion, and measure the local magnetic gradient to 0.1 nT/m, using a Bose-Einstein Condensate based atom interferometer.
Phys. Rev. Lett. **117** 138501 (2016)

2015 — Fast machine-learning online optimization of ultra-cold-atom experiments
Scientific Reports
We use machine learning to optimize laboratory production and tuning of Bose-Einstein Condensates.
Scientific Reports **6** 25890 (2016)

2014 — A Bright Solitonic Matter-Wave Interferometer
Physical Review Letters
A soliton is a non-dispersive cloud of atoms. We present the first soliton-based matter-wave interferometer, and show that using a soliton increases the visibility of the interference fringe.
Phys. Rev. Lett. **113** 013002 (2014)

2014 — A faster scaling in acceleration-sensitive atom interferometers
Europhysics Letters
The signal in an atom-optic accelerometer scales at best with the square of the time it is measured for, until now. We demonstrate a signal which scales with the cube (and higher powers) of the time it is measured for. This paper was highlighted as an Editor's Choice.
Europhysics Letters **105** 63001 (2014)

2013 — Optically guided linear Mach-Zehnder atom interferometer
Physical Review A
Cold atoms held along a horizontal tube, an optical waveguide, were used to make an acceleration sensor by interfering them with one another.
Phys. Rev. A **87**, 013632 (2013)

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