

# Curriculum Vitae

Tobias John Kenney

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## Background

**Address** Department of Mathematics and Statistics  
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Canada  
**Email** tkenney@mathstat.dal.ca  
**Date of Birth** 17th September 1979  
**Citizenship** Dual UK & Canadian citizen

## Education:

1998–2001 B.A. (1st Class in all 3 years (parts IA, IB, and IIB of the Mathematical Tripos)), University of Cambridge  
2001–2002 Certificate of Advanced Study in Mathematics (with Distinction), University of Cambridge  
2002–2006 Ph.D. (Pure Mathematics and Mathematical Statistics), University of Cambridge  
*Thesis title:* Topics in Topos Theory  
*Supervisor:* Prof. P. T. Johnstone

## Actuarial Qualification

I have passed the following preliminary examinations for the Society of Actuaries: P, FM, MFE, C, MLC.

## Employment History:

2006–2008 AARMS Postdoctoral Fellow, Dalhousie University  
*supervisors:* Prof. R. J. Wood and Prof. R. Paré  
2008–2009 Postdoctoral Researcher, Matej Bel University  
2010–2011 Postdoctoral Fellow, Dalhousie University  
*supervisor:* Prof. D. Pronk  
2011–2016 Limited Term Assistant Professor, Dalhousie University  
2016–Present Assistant Professor, Dalhousie University

## Research

### Publications:

Underlined authors were students under my supervision.

### Published and Accepted Papers:

- L. Liu, H. Gu, J. Van Limbergen, **T. Kenney**. SuRF: a New Method for Sparse Variable Selection, with Application in Microbiome Data Analysis, *Statistics in Medicine* 40 (2021), 897–919 <http://dx.doi.org/10.1002/sim.8809>
- **T. Kenney**, H. Gu, T. Huang. Poisson PCA: Poisson Measurement Error corrected PCA, with Application to Microbiome Data (To appear in *Biometrics*, 35 pages, online version: <http://dx.doi.org/10.1111/biom.13384>)
- **T. Kenney**, J. Gao, H. Gu. Application of OU processes to modelling temporal dynamics of the human microbiome, and calculating optimal sampling schemes. *BMC Bioinformatics* 21(2020) 450 (32 pages)
- W. Chen\*, **T. Kenney\***, J. Bielawski, H. Gu. Testing Adequacy for DNA Substitution Models. *BMC Bioinformatics*, 20(2019) 349 (16 pages) \* — co-first authors.
- K. A. Dunn\*, **T. Kenney\***, H. Gu and J. P. Bielawski. Improved inference of site-specific selection pressures under a generalized parametric model of codon evolution. *BMC Evolutionary Biology* 19(2019) 19:22 (19 pages). \* — co-first authors.
- Y. Cai, H. Gu, **T. Kenney**. Learning Microbial Community Structures with Supervised and Unsupervised Non-negative Matrix Factorization. *Microbiome* 5 (2017), doi 10.1186/s40168-017-0323-1 (27 pages).
- **T. Kenney**, Partial-Sup Lattices. *Theory and Applications of Categories* 30 (2015), 305–331.
- M. Abeyesundera, **T. Kenney**, C. Field and H. Gu, Combining Distance Matrices on Identical Taxon Sets for Multi-Gene Analysis with Singular Value Decomposition. *PLoS ONE* 9 (2014), e94279. doi:10.1371/journal.pone.0094279 (14 pages)
- **T. Kenney**. Coxeter Groups, Coxeter Monoids and the Bruhat Order. *Journal of Algebraic Combinatorics* 39 (2014), 719–731
- **T. Kenney**, H. Gu. Hessian Calculation for Phylogenetic Likelihood based on the Pruning Algorithm and its Applications *Statistical Applications in Genetics and Molecular Biology*, 11 (2012), issue 4, article 14 (44 pages)
- **T. Kenney** and R. Paré. Categories as Monoids in Span, Rel and Sup, *Cahiers de Topologie et Géométrie Différentielle Catégoriques*, 52 (2011), 209–240
- **T. Kenney**. The Path Relation for Directed Planar Graphs, and its Relation to the Free Diad. *Discrete Mathematics* 311 (2011), 441–456

- **T. Kenney**. Injective Power Objects and the Axiom of Choice *Journal of Pure and Applied Algebra* 215 (2011), 131–144
- **T. Kenney**. Graphical algebras — a new approach to congruence lattices *Algebra Universalis* 64 (2010), 313–338
- H. Gu, **T. Kenney** and M. Zhu. Partial Generalized Additive Models: an Information-Theoretic Approach to Selecting Variables and Dealing with Concurvity. *Journal of Computational and Graphical Statistics* 19 (2010), 531–551
- **T. Kenney**. The General Theory of Diads *Appl. Cat. Struct.* 18 (2010), 523–572
- **T. Kenney** and R. J. Wood. Tensor Products of Sup Lattices and generalized sup-arrows. *Theory and Applications of Categories* 24 (2010), 266–287
- **T. Kenney**. Diads and Their Application to Topoi, *Appl. Cat. Struct.* 17 (2009), 567–590
- **T. Kenney**. Copower Objects and their applications to Finiteness in Topoi, *Theory and Applications of Categories* 16 (2006), 923–956
- **T. Kenney**. Generating Families in a Topos, *Theory and Applications of Categories* 16 (2006), 896–922

#### Papers submitted or under revision

- **T. Kenney**, H. He, H. Gu. Prior Distributions for Ranking Problems (Under Revision, 42 pages, arXiv: <https://arxiv.org/abs/1610.08779>)
- **T. Kenney**. Consistency of Ranking Estimators. (Under revision, 13 pages, ArXiv: <https://arxiv.org/abs/1909.00747>)
- **T. Kenney**, H.Gu. The Adequate Bootstrap. (Under revision, ArXiv: <https://arxiv.org/abs/1608.05913>)
- L. Xu, X. Xu, D. Kong, H. Gu, **T. Kenney**. Stochastic Generalized Lotka-Volterra Model with An Application to Learning Microbial Community Structures (Under revision for *Journal of the American Statistical Association*, 52 pages)
- X. Zhang, H. Gu, T. Kenney. Feature and structure selection of neural networks. (Submitted to *IEEE transactions on neural networks and learning systems*)

#### Papers in preparation

- S. Ling, **T. Kenney**, C. Field, H. Gu. Model Combination for Block Missing Data.
- M. Wang, **T. Kenney**. The Influence of Utility Functions on Life Insurance Choices.
- **T. Kenney**. Euclidean Abstract Convexity Spaces.
- Y. Cai, H. Gu, **T. Kenney**. The Smoothing Spline Approach to Deconvolution.
- R. Doig, **T. Kenney**, H. Gu. Negative Binomial PCA for Overdispersed Count Data
- X. Zhang, T. Huang, T. Bennet, **T. Kenney**, A. Wu, H. Gu. Machine-learning methods in property valuation.

## Ongoing projects:

- L. Liu, H. Gu, T. Kenney. Correcting for LASSO's distributional bias.
- W. Jia, H. Gu, T. Kenney. Edge detection with application to X-ray imagery.
- W. Zhang, L. Ho, T. Kenney. Identifying shifts in OU evolution models.
- Y. Cai, H. Gu, T. Kenney. Selecting the number of types for NMF using likelihood ratio and a deconvolved bootstrap.
- X. Xu, T. Kenney, H. Gu, X. Xu. Temporal dynamics of the infant gut microbiome.
- C. Liu, R. Beiko, T. Kenney, H. Gu. The Community co-evolution model for a group of genes with interactions.
- M. Parenteau, T. Kenney, P. Munz, H. Gu. Real-time detection of violence in security surveillance systems.

## Students Supervised or Co-supervised

### Honours Theses

Name	Dates	Thesis Title
Haomu Liu	01/2021–04/2021	<i>COVID-19 Data Analysis Combined SIR Model with Actuarial Applications</i>
Haiyang Zhou	01/2021–04/2021	<i>The use of Copulas for Joint-life Modelling.</i>
Yunzheng Zhang	01/2020–04/2020	<i>Modelling Changes in Mortality</i>
Xinyuan Liu	09/2019–12/2019	<i>Effects of Regulation Limitation on Modified Hotelling Model in Health Insurance Market</i>
Fuxi Wu	01/2019–04/2019	<i>The dependence of Pareto distribution and optimal reinsurance under TVaR risk measures</i>
Cuiting Zhong	09/2018–12/2018	<i>Optimal Reinsurance Strategies</i>
Yi Luo	09/2017–04/2018	<i>Risk Aggregation in Multivariate Dependent Pareto Distribution</i>
Dimitri Duncombe	01/2016–05/2016	<i>The Hedging Effectiveness of the Swiss-Re Kortis Bond.</i>
Weisi Si.	05/2015–12/2015	<i>Hierarchical Credibility Premium Estimation: One Class is A Non-negligible Proportion of the Whole Population</i>
Yiqun Liu.	05/2015–12/2015	<i>Value-at-Risk and Tail-Value-at-Risk Estimation under Importance Sampling Distribution</i>
Jorge Goldschmied-Chale	09/2014–12/2014	<i>Topoi and Logic</i>

### NSERC USRA

Name	Dates	Topic
Renny Doig	05/2019–08/2019	<i>Negative Binomial PCA</i>

### Master's Students

Name	Dates	Thesis title or topic
Wanru Jia	09/2018–12/2020	<i>Edge Detection Operators for X-ray Images based on Hessian Matrices.</i>
Junqiu Gao	09/2017–08/2019	<i>Ornstein-Uhlenbeck Process and Optimal Sampling for Analysis of Microbiome Data.</i>
Mingzhu Wang	09/2016–04/2018	<i>The Influence of Utility Functions on Insurance Choices.</i>
Tianshu Huang	(09/2015–08/2017)	<i>Semi-Parametric Principal Component Analysis for Poisson Count Data with Application to Microbiome Data Analysis.</i>
Hao He	09/2014–04/2016	<i>Robust Ranking and Selection with Heavy-tailed Priors and its Application to Market Basket Analysis</i>
Yun Cai	09/2013–08/2014	<i>Non-negative matrix factorisation for classification of metagenomic data.</i>
Wei Dai	09/2011–08/2013	<i>A new Test to Build Confidence Regions using Balanced Minimum Evolution.</i>
Li Li	09/2011–12/2015	<i>Recombination Detection Based on Likelihood and Clustering for DNA and Amino Acid Sequences.</i>

### Ph.D. Students

Name	Dates	Thesis title or topic
Shanglun Li	01/2021–Present	Topic: <i>Time series modelling of microbiome data</i>
Wensha Zhang	09/2019–Present	Topic: <i>Variable selection methods with dependent data.</i>
Xinyue Zhang	01/2019–Present	Topic: <i>Machine learning and spatiotemporal methods in property valuation.</i>
Shen Ling	09/2014–Present	Topic: <i>Machine Learning Automated Diagnosis from Emergency Room Data.</i>
Yun Cai	09/2014–Present	Topic: <i>Non-negative matrix factorisation for classification of metagenomic data.</i>
Lihui Liu	01/2014–Present	Topic: <i>Variable selection methods with application to microbiome data.</i>

### Visiting PhD. Students

Name	Dates	Visiting from	Topic
Libai Xu	08/2019–09/2019	Nankai University	Topic: <i>Stochastic Lotka-Volterra models for microbiome data.</i>
Xueli Xu	08/2019–10/2019	Nankai University	Topic: <i>Time Series modelling of infant gut microbiome data.</i>

## Invited Lectures and Conference Presentations:

### Invited Presentations:

- *Using Stochastic Differential Equations to Model Microbial Dynamics* — BIRS Workshop 19w5221 Emerging Statistical Challenges & Methods for Analysis of Human Microbiome Data, Banff, Canada, 16/09/2019
- *Consistency of Ranking Methods* — ICSA Canada Chapter, invited session, Kingston, Canada, 10/08/2019
- *Variable Selection in OTU Data* — Invited talk, Biostatistics Symposium 2017, Guelph, Canada, 17/05/2017
- *Hessian Calculation for Phylogenetic Likelihood and its Application to Influence Analysis* — Invited Lecture, Liverpool University, UK, 2011

### Conference Presentations:

- *Asymptotic and Finite-sample Comparison of Ranking Methods* — International Workshop on Perspectives on High-Dimensional Data Analysis IX, Uppsala, Sweden, 24/06/2019
- *Using Stochastic Differential Equations to Model Microbial Dynamics* — Workshop on Statistical Analysis and Machine Learning with Application in Medicine, Biology, Environmental Sciences, Halifax, Canada, 10/05/2019
- *The Adequate Bootstrap* — EcoSta2017, Hong Kong, 17/06/2017
- *The Adequate Bootstrap — A new Method for Measuring Model Uncertainty* — International Conference on Robust Statistics 2016, Geneva, Switzerland, 07/07/2016
- *Credibility Classification with Missing Data* — International Federation of Classification Societies 2015, Bologna, Italy, 06/07/2015
- *Credibility Classification with Missing Data* — Statistics Society of Canada annual meeting 2015, Halifax, NS, Canada, 15/06/2015
- *Partial Sup-Lattices* (Poster) — CT2014 international category theory conference, Cambridge, UK, 02/07/2014
- *Graphical Composition* — Third International Symposium on Groups, Algebras and related topics, Beijing, China 12/06/2013
- *The Span Construction on Bicategories* — CT2011 international category theory conference, Vancouver, Canada 21/07/2011
- *Influence Analysis in Phylogeny* — ICORS11 International Conference On Robust Statistics, Valladolid, Spain, 2011
- *A generalized codon-based Model of Nucleotide Substitution for Protein-coding DNA Sequences* — Statistics Society of Canada annual meeting 2011, Wolfville, NS, Canada.
- *COLD — Software for Likelihood-Based Phylogenetic Analysis* — CIHR Microbiomics Grant Workshop, Dalhousie University, Canada, 2011.

- *A generalized codon-based Model of Nucleotide Substitution for Protein-coding DNA Sequences* — Centre for Comparative Genomics and Evolutionary Bioinformatics, Dalhousie University, January 2011
- *Generalised Sup Arrows and the Totally Below Relation* — Categories OctoberFest, International Category Theory Conference, Halifax, Canada, 2010
- *Span, Span, SpanSpan, SpanSpan* — CT2010 International Category Theory Conference, Genoa, Italy, 2010
- *Graphical Algebras — a New Approach to Congruence Lattices* — SSOAS2009 Summer School on General Algebra and Ordered Sets, Stará Lesná, Slovakia 2009
- *Equivalence in terms of paths between inputs and outputs of a family of planar graphs* — GEMS2009 International Conference on Graph Embeddings and Maps on Surfaces, Talé, Slovakia 2009
- *The Free Diad* — PSSL88 Peripatetic Seminar on Sheaves and Logic, Conference in honour of the 60th birthdays of Martin Hyland and Peter Johnstone, Cambridge, UK 2009
- *Diads and their Application to Topoi* — CT2008 International Category Theory Conference, Calais, France, 2008
- *Diads* — FMCS 2008 Formal Methods in Computer Science, Dalhousie University, Halifax, NS, Canada, 2008
- *The Connection Between Equivalence Relations and Subgroups* — CT07 International Category Theory Conference, Carvoeiro, Portugal, 2007
- *Injective Power Objects & the Axiom of Choice* — CT06 International Category Theory Conference, White Point, NS, Canada 2006
- *Copower Objects* — Summer School on Topos Theory, Haute Bodeux, Belgium, 2005

### Grant Awards

2014–2021 NSERC Discovery Grant RGPIN-2014-04945, annual amount \$15,000  
 2019–2023 Mitacs Accelerate (PVSC) (Application ref: IT15471) total amount \$106,666.67



## Teaching

### Courses Taught

Year	Course Number	Course Name	Students Enrolled
2006–2007	MATH 3090	Advanced Calculus	
	MATH/CSCI 2112	Discrete Structures II	
2007–2008	MATH 2051	Problems in Geometry	12
	MATH/CSCI 2113	Discrete Structures II	
2010–2011	MATH/STAT 2600	Theory of Interest	12
	MATH 1115	Mathematics for Commerce	125
2011–2012	MATH/STAT 3360	Probability	25
	MATH 1001	Mathematics for Liberal Arts	14
2012–2013	MATH 3030X	Abstract Algebra	19
	MATH/STAT 3360	Probability	32
	MATH 3030Y	Abstract Algebra	19
2013–2014	MATH/STAT 2600	Theory of Interest	33
	MATH/STAT 3360	Probability	32
	MATH/STAT 3460	Intermediate Statistical Theory	19
2014–2015	MATH/STAT 2600	Theory of Interest	60
	MATH/STAT 3360	Probability	51
	ACSC/STAT 3703	Actuarial Models I	29
	ACSC/STAT 3720	Life Contingencies I	35
2015–2016	ACSC/STAT 4703	Actuarial Models II	6
	ACSC/STAT 4720	Life Contingencies II	7
	ACSC/STAT 3720	Life Contingencies I	22
2016–2017	ACSC/STAT 4703	Actuarial Models II	6
	ACSC/STAT 4720	Life Contingencies II	7
	ACSC/STAT 3720	Life Contingencies I	16
	MATH/STAT 3460 *	Intermediate Statistical Theory	
	STAT 5750 *	Data Mining	
2017–2018	ACSC/STAT 4703	Actuarial Models II	8
	ACSC/STAT 4720	Life Contingencies II	7
	ACSC/STAT 3720	Life Contingencies I	21
2018–2019	ACSC/STAT 4703	Actuarial Models II	6
	ACSC/STAT 4720	Life Contingencies II	8
2019–2020	ACSC/STAT 4703	Actuarial Models II	12

\* Covered for the second half of term, when the original instructor broke her arm and was unable to teach for the second half of the term.

### New Courses Developed

**ACSC/STAT 3703** First taught in WINTER 2015. This course is an introduction to modelling of Actuarial data. It covers a range of topics about probability distributions. It covers distributional quantities such as moments, percentiles, risk measures

and probability generating functions. It also covers families of continuous and discrete distributions, and the links between distributions in these families. It also covers methods of altering existing distributions to create new distributions, and introduces compound models for aggregate loss.

**ACSC/STAT 3720** First taught in WINTER 2015. This course is an introduction to life contingencies. It includes survival models, life tables, valuation of insurance benefits and annuities, calculation of premiums, and policy values.

**ACSC/STAT 4703** First taught in FALL 2015. This course covers a range of topics used in actuarial modelling. When first taught, the course covered calculation of aggregate loss distributions; nonparametric estimation; Bayesian inference; model selection; credibility theory; and simulation. I updated the syllabus in 2018 to reflect changes to the Society of Actuaries exam syllabus. The new syllabus replaced the topics on non-parametric estimation, Bayesian inference and simulation with topics relating to insurance: types of short-term insurance coverage; loss reserving; ratemaking; and various other topics.

**ACSC/STAT 4720** First taught in FALL 2015. This course covers more advanced topics in life contingencies. The original topics were: multiple state models, including joint life insurance; pensions; yield rate risk and other non-diversifiable risks; profit testing; participating and universal life insurance; Equity-linked insurance. I updated the syllabus in 2018 to reflect changes to the Society of Actuaries exams: the topics on non-diversifiable risk, participating and universal life insurance and equity-linked insurance were replaced by the following topics: Mortality improvement modelling; and non-parametric estimation of survival functions.

**ACSC/STAT 3740 (in progress)** This will be first taught in WINTER 2021. It will cover the entire process of statistical analysis, starting from formulation of the problem, then selection of data, data validation and exploration, data visualisation, modelling, and communication. There will be some revision of machine-learning methods used, but these will have been covered in the prerequisite courses, and the focus of this course is on using the available tools to completely analyse a problem.

## **Administration**

### **Actuarial Science**

#### **Program Development**

From 01/2014–05/2015, I developed the new Actuarial Science degree programme at Dalhousie. This involved preparing an initial concept paper outlining what would be needed for the new programme, and why the new program would be a benefit. After this was approved, I wrote a more in-depth 34 page document providing details of the new programme curriculum; expected graduate outcomes; comparison with similar existing programs at universities in the Maritimes; the resources needed; and its impact on university enrollments, existing programmes and other universities. This was also supplemented with a 104-page appendix providing detailed support for the main programme proposal. Writing this report required consultation with Faculty members in charge of similar programmes at other universities; potential employers of future graduates; senior administrators at other universities in the Maritimes; Dalhousie university senior administrators in various roles; Department heads and Faculty deans for various departments with related courses. In addition to the major and honours programme, this report also developed a minor in Actuarial Science, and a postbaccalaureate diploma in Actuarial Science.

#### **Advising**

From 09/2016–Present I have been the advisor for Actuarial Science. This involves advising students about the actuarial science programme needs, both for majors and honours students. It also involves co-ordinating the honours thesis course, to ensure that all honours students have a supervisor for their honours thesis. It also involves responding to email enquiries from prospective students interested in one of the university’s Actuarial Science programmes, and reviewing applications to the diploma in Actuarial Science.

#### **SoA Liason**

From 09/2016–Present I have been the University’s Society of Actuaries Contact person. This involves various tasks relating to the Actuarial Science programme:

- Ensuring that the information about the Actuarial Science programme kept by the Society of Actuaries remains up-to-date
- Applying for biennial renewal of VEE status for university courses.
- Applying on behalf of students for various SoA schemes, such as examination fee refunds.
- Receiving and responding to information from the Society of Actuaries.

#### **Other Actuarial Science Duties**

From 09/2016–Present, I have been in charge of the Actuarial Science programme at Dalhousie. The main tasks involved in this role are as follows:

- Editing the university calendar entry for Actuarial Science each year to ensure it is up-to-date.
- Checking graduates from the programme and related certificates.
- Arranging recruitment events with local employers.

### **Committee work**

- Data Science Committee chair 04/2020–Present
- Senior Instructor Committee member 09/2017–10/2017