Marcus Pivato

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Citizenship:	Canadian.
Date of Birth:	1974, March 18.
Education:	Ph.D. in Mathematics, University of Toronto (2001).
	B.Sc. in Mathematics, University of Alberta (1994).
Current Position:	Associate Professor, Department of Mathematics, Trent University.
	Member, Graduate Program in *Applications of Modeling in the Natural and Social Sciences*, Trent University.
	Member, Editorial Board for *Journal of Cellular Automata.*

Research Interests: Social choice theory and voting theory.
   Cellular automata, symbolic dynamics and ergodic theory.

Awards and Honours:

TRENT UNIVERSITY:

2008-2013:	NSERC Discovery Grant. ($90,000, *'Emergent Defect Dynamics in Cellular Automata.'*)
2006:	Promoted to Associate Professor.
2005:	Merit Award for exceptional performance in research and university service.
2004:	Nominated for Symons Teaching Award.
2003-2008:	NSERC Discovery Grant. ($50,000, *'Asymptotic Randomization in Cellular Automata.'*)

UNIVERSITY OF TORONTO:

2000-2001:	MITACS Research Assistantship.
1999-2000:	Ontario Graduate Scholarship.
1995-1999:	NSERC Postgraduate Scholarship.

UNIVERSITY OF ALBERTA:

1994:	Dean's Silver Medal in Science.
1990-1994:	Canada Scholarship.
1993-1994:	Murray Thomas Gibson Award in Mathematics.
1992:	NSERC Undergraduate Award.

Publications: (Copies of selected publications appear in attached research portfolio.)

Book. *Linear Partial Differential Equations and Fourier Theory,* 630 pages, Cambridge University Press, 2010. ISBN: 978-0521136594   [http://www.cambridge.org/us/catalogue/

`catalogue.asp?isbn=0521136598`]   [`http://euclid.trentu.ca/pde.pdf`]

[1] *The ergodic theory of cellular automata*, M. Pivato; to appear in *International Journal of General Systems*, 2012.

[2] *The McGarvey problem in judgement aggregation*, Klaus Nehring and M. Pivato; to appear in *Discrete Applied Mathematics* (2011). [`http://mpra.ub.uni-muenchen.de/22600/`]

[3] *Positive expansiveness versus network dimension in symbolic dynamical systems*, M. Pivato, *Theoretical Computer Science* **412** #30 (2011), 3838-3855. [`http://arxiv.org/abs/0907.2935`]

[4] *Emulating Bratteli-Vershik adic systems using cellular automata*, M. Pivato and Reem Yassawi. *Ergodic Theory & Dynamical Systems*, (2010), **30**, 1561-1572. [`http://arxiv.org/abs/0710.3608`]

[5] *Geometric models of consistent judgement aggregation*, M. Pivato, *Social Choice & Welfare*, **33** (#4), November 2009, pp.559-574. [`http://ideas.repec.org/p/pra/mprapa/9608.html`]

[6] *Pyramidal Democracy*, M. Pivato, *Journal of Public Deliberation*, Vol. **5** (#1), 2009, Article 8. [`http://services.bepress.com/jpd/vol5/iss1/art8`]

[7] *Emergent defect dynamics in two-dimensional cellular automata*, by Martin Delacourt and M. Pivato, *Journal of Cellular Automata*, **4** (#2), 2009, pp. 111-124. (Proceedings of *Automata 2007* conference).

[8] *The ergodic theory of cellular automata*, in the *Encyclopedia of Complexity and System Science*, Robert A. Meyers, ed. (Springer-Verlag, 2009). [`http://euclid.trentu.ca/pivato/Research/ergodic.CA.pdf`]

[9] *Twofold optimality of the relative utilitarian bargaining solution*, M. Pivato, *Social Choice & Welfare* **32** (#1), January 2009, pp.79-92. [`http://ideas.repec.org/p/pra/mprapa/2637.html`]

[10] *Module shifts and measure rigidity in linear cellular automata*, M. Pivato, *Ergodic Theory & Dynamical Systems*, **28**, (#6), December 2008, pp. 1945-1958. [`http://arxiv.org/abs/0707.1408`]

[11] *The spatial structure of odometers in certain cellular automata.* by M. Pivato and Reem Yassawi. Proceedings of *Journées Automates Cellulaires* (Uzès, France; April 21-25, 2008), pp. 119-129. [`http://www.lif.univ-mrs.fr/jac/actes/119-129.pdf`]

[12] *Defect particle kinematics in one-dimensional cellular automata*, M. Pivato, *Theoretical Computer Science*, **377**, (#1-3), May 2007, pp.205-228. [`http://arxiv.org/abs/math.DS/0506417`]

[13] *RealLife: the continuum limit of Larger than Life cellular automata*, M. Pivato, *Theoretical Computer Science*, **372** (#1), March 2007, pp. 46-68. [`http://arxiv.org/abs/math.DS/0503504`] (MR2299025)

[14] *Prevalence of odometers in cellular automata*, Ethan M. Coven, M. Pivato, and Reem Yassawi. *Proceedings of the American Mathematical Society*, **135**, March 2007, pp.815-821. [`http://arxiv.org/abs/math.DS/0511030`] (MR2262877)

[15] *Spectral domain boundaries in cellular automata*, M. Pivato, *Fundamenta Informaticae*, **78** (#3), 2007, pp.417-447. [`http://arxiv.org/abs/math.DS/0507091`] (MR2346874)

[16] *Algebraic invariants for crystallographic defects in cellular automata,* M. Pivato, *Ergodic Theory & Dynamical Systems,* **27** (#1), February 2007, pp. 199-240. [http://arxiv.org/abs/math.DS/0507167] (MR2297094)

[17] *Asymptotic randomization of subgroup shifts by linear cellular automata,* Alejandro Maass, Servet Martinez, M. Pivato, and Reem Yassawi, *Ergodic Theory & Dynamical Systems,* **26** (#4), October 2006, pp.1203-1224.   [http://euclid.trentu.ca/pivato/Research/groupshift.pdf] (MR2247638)

[18] *Asymptotic randomization of sofic shifts by linear cellular automata,* M. Pivato and Reem Yassawi, *Ergodic Theory & Dynamical Systems* **26** (#4), October 2006, pp.1177-1201. [http://arXiv.org/abs/math.DS/0306136] (MR2247637)

[19] *Attractiveness of the Haar measure for the action of linear cellular automata in Abelian topological Markov chains,* by Alejandro Maass, Servet Martinez, M. Pivato and Reem Yassawi, pp. 100 - 108, in *Dynamics and Stochastics: Festschrift in honour of Michael Keane* (volume **48** of Lecture Notes Monograph Series of the Institute for Mathematical Statistics), 2006. [http://euclid.trentu.ca/pivato/Research/keane.pdf]

[20] *Cellular automata vs. quasisturmian shifts,* M. Pivato, *Ergodic Theory & Dynamical Systems,* **25** (#5), October 2005, pp. 1583-1632. [http://arXiv.org/abs/math.DS/0306136] (MR2173435)

[21] *Invariant measures for bipermutative cellular automata,* M. Pivato, *Discrete & Continuous Dynamical Systems A,* **12** (#4), April 2005, pp. 723 - 736. [http://arXiv.org/abs/math.DS/0306211] (MR2129368)

[22] *Limit measures for affine cellular automata II,* M. Pivato and Reem Yassawi, *Ergodic Theory & Dynamical Systems,* **24** (#6), 2004, pp. 1961-1980 [http://arXiv.org/abs/math.DS/ 0108083] (MR2106773)

[23] *Interior symmetry and local bifurcation in coupled cell networks,* by Martin Golubitsky, M. Pivato, and Ian Stewart, *Dynamical Systems: an International Journal,* **19** (#4), 2004, pp.389-407. [http://euclid.trentu.ca/pivato/Research/interior.pdf] (MR2107649)

[24] *Symmetry groupoids and patterns of synchrony in coupled cell networks,* by Martin Golubitsky, M. Pivato, and Ian Stewart, *SIAM Journal of Applied Dynamical Systems,* **2** (#4), 2003, pp. 609 - 646. [http://epubs.siam.org/sam-bin/dbq/article/41989] (MR2050244)

[25] *Estimating the spectral measure of a multivariate stable distribution via spherical harmonic analysis,* M. Pivato and L. Seco, *Journal of Multivariate Analysis,* **87** (#2), November 2003, pp. 219-240. [http://euclid.trentu.ca/∼pivato/Research/stable.ps.gz] (MR2016936)

[26] *Multiplicative cellular automata on nilpotent groups: Structure, entropy, and asymptotics,* M. Pivato, *Journal of Statistical Physics,* **110**(#1/2), January 2003, pp. 247-267. [http://arXiv.org/abs/math.DS/0108084] (MR1966329)

[27] *Conservation laws for cellular automata,* M. Pivato, *Nonlinearity,* **15**, 2002, pp. 1781-1793. [http://arXiv.org/abs/math.DS/0111014] (MR1938472)

[28] *Limit measures for affine cellular automata,* M. Pivato and Reem Yassawi, *Ergodic Theory & Dynamical Systems,* **22**(#6), 2002, pp. 1269-1287. [http://arXiv.org/abs/math.DS/0108082] (MR1926287)

[**29**] *Building a stationary stochastic process from a finite-dimensional marginal,* M. Pivato, *Canadian Journal of Mathematics,* **53**(#2), 2001, pp. 382-413.
[`http://arXiv.org/abs/math.DS/0108081`] (MR1820914)

[**30**] *Measures of dependence for multivariate Lévy distributions,* Jeff Boland, Tom Hurd, M. Pivato and Luis Seco, *Disordered and Complex Systems* (London, 2000) pp. 289-295; American Institute of Physics Conference Proceedings vol. **553**.
[`http://www.math.mcmaster.ca/tom/levy.ps`] (MR1870901)

Doctoral Thesis: *Analytical Methods for Multivariate Stable Probability Distributions,* Department of Mathematics, University of Toronto, 2001. (Supervisor: Luis Seco.)

Invited Talks:

1. *Quasiutilitarian social choice with approximate interpersonal comparisons of welfare gains,* Laurier Centennial Conference (AMMCS-2011). Waterloo, Ontario, July 25-29, 2011. [`http://www.ammcs2011.wlu.ca`]

2. *Additive Representation of Separable Preferences over Infinite Products,* Laurier Centennial Conference (AMMCS-2011). Waterloo, Ontario, July 25-29, 2011.
[`http://www.ammcs2011.wlu.ca`]

3. *Quasiutilitarian social choice with approximate interpersonal comparisons of welfare gains,* New Directions in Welfare, Paris, France, July 6-8, 2011.
[`http://www.open.ac.uk/socialsciences/welfareconomicstheory/`]

4. *A statistical approach to epistemic democracy,* Episteme conference, "Social Epistemology meets Formal Epistemology", Carnegie Mellon University, Pittsburg, PA. June 24-26, 2011.

5. *Additive Representation of Separable Preferences over Infinite Products,* North American Summer Annual Meeting of the Econometric Society, St.Louis, MO, June 9-12, 2011.

6. *Additive Representation of Separable Preferences over Infinite Products,* Department of Mathematics, SUNY Pottsdam, NY, June 3, 2011.

7. *The McGarvey Problem in Judgement Aggregation,* Seminar of Laboratoire de combinatoire et d'informatique mathématique (LaCIM) at Université du Quebec au Montréal. April 15, 2011. [`http://lacim.uqam.ca/seminaire`]

8. *Social choice with approximate interpersonal comparisons of utility,* Choice Group Seminar of the London School of Economics, February 15, 2011 [`http://www2.lse.ac.uk/CPNSS/projects/CoreResearchProjects/ChoiceGroup/choice_group_events.aspx`]

9. *Additive Representation of Separable Preferences over Infinite Products,* Montreal Natural Resources and Environmental Economics Workshop, January 14, 2011
[`http://www.cireq.umontreal.ca/resenv/resenv11.html`]

10. *Social choice with approximate interpersonal comparisons of utility,* Montreal Economic Theory Reading Group, October 14, 2010

11. *Supermajoritarian efficient judgement aggregation*, 10th International Meeting of the Society for Social Choice and Welfare, Moscow, July 2010 (joint work with Klaus Nehring). [`http://www.hse.ru/conf/sscw2010/judgement_aggregation.html`]

12. *Social choice with approximate interpersonal comparisons of utility*, 10th International Meeting of the Society for Social Choice and Welfare, Moscow, July 2010. [`http://www.hse.ru/conf/sscw2010/judgement_aggregation.html`]

13. *Module shifts and measure rigidity in linear cellular automata*, Special Session on *Algebraic Dynamics* at the Joint Meetings of AMS/MAA, San Diego (January, 2008).

14. *Automata 2007*, Fields Institute, Toronto, Canada, August 27-29, 2007.

15. *CanaDAM 2007*, BIRS, Alberta, Canada. May 28-31, 2007.

16. *Defect kinematics in cellular automata* and *RealLife Euclidean automata* (one hour each). Workshop on *Information propagation in cellular automata*, Ecole Normale Supérieure de Lyon, February 19-21, 2007. (All expenses paid by ENS Lyon).

17. *Cohomological crystallographic defects in cellular automata*, Southern Ontario Dynamics Day, Fields Institute, Toronto. April 7, 2006.

18. *Spectral crystallographic defects in cellular automata*. Session on *Ergodic Theory* at the Winter 2005 meeting of the Canadian Mathematical Society, Victoria, British Columbia, December 10-12, 2005.

19. *Defect particle dynamics in cellular automata*, Seminar on *Modelling and Computational Science* at the University of Ontario Institute of Technology, Oshawa, November 18, 2005. [`http://euclid.trentu.ca/pivato/Research/defectslides.pdf`]

20. *Propagating structures in cellular automata*. Two one-hour lectures at Departamento de Ingeniería Matemática, Universidad de Chile, Santiago, October 25-26, 2005.

21. *Crystallographic defects in cellular automata*. Special session on *Measurable, Symbolic, and Tiling Dynamical Systems* of the Eastern Section Meeting of the American Mathematical Society, Bard College, Annandale-on-Hudson, New York, October 8-9, 2005 [`http://euclid.trentu.ca/pivato/Research/defectslides.pdf`]

22. *RealLife: the continuum limit of Larger than Life cellular automata*. Colloquium lecture at the Department of Mathematics & Statistics, University of Guelph, October 7th, 2004 [`http://euclid.trentu.ca/pivato/Research/lifeslides.pdf`]

23. *Cellular automata vs. quasisturmian systems*, at the *Fifth international conference on Dynamical Systems and Differential Equations*, California State Polytechnic University, Pomona, June 16 - 19, 2004. [`http://euclid.trentu.ca/pivato/Research/qcaslides.pdf`]

24. *Asymptotic randomization of sofic shifts by linear cellular automata,* at the Joint International Meeting of the American Mathematical Society and the Real Sociedad Matematica Espanola, Seville, Spain, June 18-21, 2003. [`http://euclid.trentu.ca/∼pivato/Research/seville.pdf`]

25. *Limit measures for affine cellular automata*, at the *Workshop on Dynamics and Randomness*, Departamento de Ingeniería Matemática, Universidad de Chile, Santiago, December, 2000. [`http://euclid.trentu.ca/∼pivato/Research/wdr.ps.gz`]

Other scholarly activities:

Miscellaneous.
2008: Invited to join the newly created Working Group 1.5 (*Cellular Automata and Discrete Complex Systems*) of the IFIP (*International Federation for Information Processing*).

2006: Invited to write article [**8**] for *Encyclopaedia of Complexity & System Science.* [http://refworks.springer.com/mrw/index.php?id=259]

Research Grant Refereeing.
2011: External referee for ECOS-CONICYT (France-Chile)

2009: External referee for NSERC Discovery Grant application #23****

2008: External referee for FONDECYT grant #10905**(Chile).

2008: External referee for FONDECYT grant #10901**(Chile).

2007: External referee for FONDECYT grant #10805**(Chile).

2004: External referee for NSERC Discovery Grant application #23****

2003: External referee for NSERC Discovery Grant application #24***

Conference Organization.
2011: Member of the Program Committee of the *17th International Workshop on Cellular Automata and Discrete Complex Systems* (AUTOMATA 2011).

2004: Organized a special session on 'Cellular Automata and Multidimensional Symbolic Dynamics' at the *Fifth international conference on Dynamical Systems and Differential Equations* at California State Polytechnic University, Pomona, June 16 - 19, 2004. [http://aimsciences.org/AIMS-Conference/lameeting.htm]

Supervision/Training.

May 1, 2009 to August 31, 2009: Supervised a NSERC USRA recipient, Erik Cameron, in a project entitled, *Susceptibility to strategic voting in median and mean voting systems.*

May 1, 2008 to August 31, 2008: Supervised a NSERC USRA recipient, Erik Cameron, in a project entitled, *Nomos dynamics and self-selective voting rules.*

May 1, 2007 to August 31, 2007: Supervised a visiting graduate student from ENS Lyon, Martin Delacourt, in a project entitled, *Emergent Defect Dynamics in 2-dimensional Cellular Automata.*

September 12, 2006: Chair of M.Sc. thesis defense for Michael Jack in the AMINSS graduate program at Trent University. (Supervisor: Brian Patrick. Title: *Workload Modeling and Internal Backfilling for Parallel Job Scheduling*).

May 1, 2006 to August 31, 2006: Supervised a Herzberg Award recipient, Joshua Grant, in a project entitled, *Dynamics of Voting Networks.*

September 1, 2005 to August 31, 2006: (with Reem Yassawi) co-supervised a postdoctoral fellow, Pierre Tisseur, who did research on cellular automata and automaton networks.

October 28, 2005: External examiner for the Ph.D. defense of Marcelo Sobottka, at the Departamento de Ingeniería Matemática, Universidad de Chile, Santiago. (Supervisors:

Alejandro Maass and Servet Martínez. Title: *Representación y Aleatorización en sistemas dinámicos de tipo algebraico*).

May 1 to August 31 2004: Supervised an NSERC Undergraduate Student Research Award (USRA) recipient, Matthew Drescher, in a project entitled, *Emergent Statistical Physics of Particle-Preserving Cellular Automata*. Over the summer, Matthew developed software to perform efficient, very large-scale simulations of cellular automata systems, to test for emergent hydrodynamic or thermodynamic properties.

Journal Refereeing.	2011	*Social Choice & Welfare.* (3 papers)
	2010	*Economics and Philosophy.*
		Journal of Political Economy.
	2009	*Social Choice & Welfare.* (2 papers)
	2007	*Theoretical Informatics and Applications.*
		Dynamical Systems.
		Journal of Cellular Automata.
	2006	*Nonlinearity.*
		Stochastics and Dynamics.
	2005	*Discrete & Continuous Dynamical Systems* **A**.
		Ergodic Theory & Dynamical Systems (2 papers).
		Topology and its Applications.
	2004	*Discrete & Continuous Dynamical Systems* **A**.
		Journal of Physics **A** *(Mathematical and General)*
	2003	*Discrete & Continuous Dynamical Systems* **A**.
		Nonlinearity.
		Proceedings of the London Math. Society.

Math Reviews/Zentralblatt.

(Zbl) Alcantud, José and Mehta, Ghanshyam B. Constructive utility functions on Banach spaces *J. Math. Anal. Appl.*, 350, No. 2, 590–600 (2009).

(Zbl 1188.37010) Buescu, Jorge. Liapunov stability and the ring of P-adic integers *São Paulo J. Math. Sci.*, 2, No. 1, 77–84 (2008).

(Zbl 1151.91412) Addario-Berry, L.; Reed, B.A. Ballot theorems, old and new. *Horizons of combinatorics.* Bolyai Society Mathematical Studies 17, 9–35 (2008).

(Zbl 1151.91036) Balinski, Michel. Fair majority voting (or how to eliminate gerrymandering). *American Mathematical Monthly*, 115, No. 2, 97-113 (2008).

(Zbl 1169.91008) Tanino, Tetsuzo; Moritani, Atsushi; Tatsumi, Keiji. Coalition formation in convex TU-games based on population monotonicity of random order values. *J. Nonlinear Convex Anal.* 9, No. 2, 273-281 (2008).

(Zbl 1147.37009) Boyle, Mike; Lee, Bryant. Jointly periodic points in cellular automata: Computer explorations and conjectures. *Experimental Mathematics* 16 (2007), no.3, 293-302.

(MR2334506) Biely, Christoly; Dragosits, Klaus; Thurner, Stefan. The prisoner's dilemma on co-evolving networks under perfect rationality. *Phys. D* 228 (2007), no. 1, 40–48.

(MR2304535) Aragonés, Enriqueta. Government formation in a two dimensional policy space. *Internat. J. Game Theory* 35 (2007), no. 2, 151–184.

(MR2285112) Aguiar, Manuela A. D.; Dias, Ana Paula. Minimal coupled cell networks. *Nonlinearity* 20 (2007), no. 1, 193–219.

(MR2260266) Leite, Maria da Conceição A; Golubitsky, Martin. Homogeneous three-cell networks. *Nonlinearity* 19 (2006), no. 10, 2313–2363.

(MR2237146) Elmhirst, Toby; Golubitsky, Martin. Nilpotent Hopf bifurcations in coupled cell systems. *SIAM J. Appl. Dyn. Syst.* 5 (2006), no. 2, 205–251

(MR2151603) Putnam, Ian F. Lifting factor maps to resolving maps. *Israel J. Math.* 146 (2005), 253–280.

Employment:

Professor	Trent University	07/2002 -
	(except for research leave, 01/2005 - 06/2005)	
Researcher	Wesleyan University	01/2005 - 05/2005.
Postdoctoral Fellow	University of Houston	08/2001 - 05/2002.
Studied equivariant dynamics and coupled cell systems.		**Supervisor**: Martin Golubitsky
Research Assistant	University of Toronto RiskLab	07/2000 - 06/2001.
Investigated risk management methodologies in electricity markets.		**Supervisor**: Luis Seco

Teaching experience.

TRENT UNIVERSITY:

Spring 2010	Math 1100	*Single-variable calculus* (continued from fall).
	Math 4951H	*Voting, Bargaining, and Social Choice.*
Fall 2009	Math 1100	*Single-variable calculus.*
	Math 3350H	*Linear Programming.*
	AMOD 5610H	*Foundations of Modelling.*
Spring 2009	Math 1100	*Single-variable calculus* (continued from fall).
	Math 3210H	*Mathematical Cryptography.*
	Math 4950H	*Game Theory.*
Fall 2008	Math 1100	*Single-variable calculus.*
	AMOD 5610H	*Foundations of Modelling.*
Spring 2008	Math 320H	*Number Theory.*
	Math 332H	*Groups & Symmetry.*
	Math 433H	*Algebraic Topology & Homological Algebra* (reading course).
Fall 2007	Math 220H	*Introduction to Pure Mathematics.*
Spring 2007	Math 310H	*Metric Spaces.*
	Math 472H	*Fractals and Complex Dynamics.*
One third[‡] of	Math 492H	*Perspectives in Mathematics*
Fall 2006	Math 220H	*Introduction to Pure Mathematics.*
	Math 471H	*Chaos, Symbolic Dynamics, and Fractals.*
Spring 2006	Math 310H	*Metric Spaces.*
	Math 322	*Number Theory* (continued from fall).
	Math 426H	*Differential Geometry.*
	Math 497H	*Voting, Bargaining and Social Choice* (reading course, one student).
Fall 2005	Math 220H	*Introduction to Pure Mathematics.*
	Math 322	*Number Theory.*
Spring 2005	(Research leave at Wesleyan University)	
Fall 2004	Math 220H	*Introduction to Pure Mathematics.*
	Math 305H	*Partial Differential Equations.*
	Math 306H	*Complex Analysis.*
	Math 406H	*Real Analysis & Measure Theory* (reading course, two students)
Spring 2004	Math 306H	*Complex Analysis.*
	Math 330	*Algebra III: Groups, Rings & Fields* (continued from fall).
One sixth[†] of	Math 491H	*Perspectives in Mathematics*
Fall 2003	Math 305H	*Partial Differential Equations.*
	Math 330	*Algebra III: Groups, Rings & Fields.*
Spring 2003	Math 110	*Single-variable Calculus* (continued from fall).
	Math 330	*Algebra III: Groups, Rings & Fields* (continued from fall).
One third[*] of	Math 207H	*Introduction to numerical & computational methods.*
Fall 2002	Math 110	*Single-variable Calculus.*
	Math 330	*Algebra III: Groups, Rings & Fields.*

University of Houston:

2001-2002   Math 3363   *Introduction to Partial Differential Equations.*

University of Toronto:

Spring 2000   Math 233   *Second-Year Linear Algebra.*

(‡) Math 492H is a team-taught course, with three instructors, each of whom teaches a four-week segment.

(†) Math 491H was a team-taught course, with six instructors, each of whom taught a two-week segment.

(∗) R. Yassawi and myself taught Math 207 from March 1 to April 30, after the original instructor took stress leave.

Teaching evaluations for 2002-2008 are available on the web at

http://euclid.trentu.ca/pivato/evals.pdf

Curriculum Development Activities: In 2004, I designed `Math 220H` (*Introduction to Pure Mathematics*), a new course to prepare Trent math majors to take advanced courses in the pure mathematics curriculum (e.g. abstract algebra, real analysis, topology). The `Math 220H` syllabus begins with basic set theory and proof techniques (*modus ponens*, induction, contradiction), and then introduces number theory (divisibility, primality, modular arithmetic), combinatorics, transfinite arithmetic, and elementary abstract algebra and topology. I taught `Math 220H` in 2004, 2005, 2006, and 2007. [http://euclid.trentu.ca/220/]

In the summer of 2006, I chaired a committee which implemented major reforms to the mathematics curriculum at Trent University, based mainly upon a draft proposal which I had prepared earlier in 2006. These reforms more efficiently allocated our limited teaching resources, while offering our students a more flexible program and a broader variety of advanced courses. We split, redesigned, rescheduled and renumbered many existing courses, and also created several new courses, including the following ones which I designed:

`MATH 285H` *The Mathematics of Art, Architecture and Music.*

`MATH 302H` *Differential Geometry.*

`MATH 321H` *Mathematical Cryptography.*

`MATH 433H` *Homological Algebra & Algebraic Topology.*

`MATH 435H` *Modules, Multilinear Algebra, & Linear Groups.*

`MATH 437H` *Commutative Algebra & Algebraic Geometry.*

Other teaching activities.   In November 2007, I delivered a 3-hour presentation on *The mathematics of voting and elections*, to a class of Grade 9 & 10 students from Lindsay Collegiate Secondary School.

In May 2008, I delivered two full-day sessions on *The mathematics of voting and elections*, as part of Trent's *Mini Enrichment* 2008 (for Grade 7 & 8 students). [http://euclid.trentu.ca/pivato/Teaching/math.voting.pdf]

In May-June 2008, I gave a minicourse on *Cooperative Game Theory* (4-6 hours of lectures per week), covering Ch.4-5 of *Axioms of Cooperative Decision-Making*, by H. Moulin. (1988, Cambridge UP), and Ch.9 of of *Game Theory: Analysis of Conflict*, by R.B.Myerson (1991, Harvard UP).

Research interests

My current research focus is the theory of social choice and social welfare. In particular, I am interested in judgement aggregation, interpersonal utility comparisons, non-ordinal preference aggregation, and deliberative democracy.

In the field of judgement aggregation, I am collaborating with Klaus Nehring and Clemens Puppe to search for judgement aggregation rules which best represent the 'majority will' in settings where propositionwise majority vote leads to logical inconsistencies. In one project, we are studying the *Condorcet efficient set*: the set of judgements which agree with the majority in a maximal set of coordinates. In the setting of preference aggregation, this corresponds to the *top cycle*. In the setting of *diachronic* judgement aggregation (where propositions are decided sequentially rather than simultaneously, with earlier decisions imposing logical constraints on later decisions), the Condorcet efficient set is the set of all outcomes that can be reached through some path. We have shown that, for many judgement aggregation problems, this set is quite large —indeed, sometimes it is the entire feasible set. This means that Condorcet efficiency alone is inadequate as a judgement aggregation principle. It also means that the problem of path-dependency in diachronic judgement aggregation can be very severe.

In another project, we consider *supermajoritarian efficient* (SME) *judgement aggregation*, a refinement of Condorcet efficiency based on the premise that one is justified in overruling a majority on one proposition *only* if this is necessary to agree with a larger supermajority on some other proposition. Typically we imagine the space of feasible judgements as a subset $\mathcal{X}$ of the Hamming cube, which in turn we regard as a subset of Euclidean space. A very important class of supermajoritarian rules are the *additive rules*, where the social decision is obtained by solving a linear program on $\mathcal{X}$ defined by the vector of majority margins. This class includes the Slater rule and the Median rule (also called the Kemeny rule). We have shown that additive rules have several distinctive properties within the class of SME rules.

In the field of interpersonal utility comparisons, I have been studying the question of how to construct social welfare functions when only 'approximate' interpersonal comparisons of well-being are possible. For example, we might suppose that the statement, 'Juan is happier than Sue' is meaningful (and perhaps, empirically testable) if the psychologies of Juan and Sue are similar enough, or if the difference in their levels of well-being is large enough. This leads to a partial ordering of the set of psychophysical states, which can be used to construct a (partial) social welfare order. In another model, I suppose that the 'true' utility levels of Juan and Sue are hidden variables about which we have some partial information —I model this by treating their (joint) utility function as a random variable. Using this, I construct a 'stochastic' version of Harsanyi's social aggregation theorem.

By 'non-ordinal preference aggregation', I mean voting systems which use richer preference information than the preference orders used in the classical Arrovian theory. For example, I am interested in *relative utilitarianism* (also sometimes called *range voting* or *score voting*) where voters assign each alternative a real-valued 'score' in the interval [0,1]. The alternative with the highest average score is the social choice. Intuitively, this seems like a good way to aggregate preferences (aside from the obvious manipulation issues), but

it is not easy to formalize this intuition.

Deliberative democracy is an excellent idea in theory, but in practice it is hard to implement in a polity with millions of people. I am interested in the feasibility of implementing deliberative democracy using a pyramidal structure of delegation. So far, this work is less mathematically rigorous than my other projects, because 'deliberation' is a complex collective cognitive activity which is extremely difficult to mathematically model.