

# Matthew Badger

## Curriculum Vitae

<https://badger.math.uconn.edu/>

matthew.badger@uconn.edu

### Employment and Visiting Positions

#### UNIVERSITY OF CONNECTICUT

- Associate Professor, Department of Mathematics, Fall 2019 – *present*
- Assistant Professor, Department of Mathematics, Fall 2014 – Summer 2019

#### STONY BROOK UNIVERSITY

- James H. Simons Instructor, Department of Mathematics, Fall 2011 – Spring 2014.

#### VISITING POSITIONS

- PCMI, Harmonic Analysis, July 2018.
- MSRI, Harmonic Analysis, January – March 2017.
- IPAM, Interactions Between Analysis and Geometry, March – June 2013.

### Education

#### UNIVERSITY OF WASHINGTON

- Ph.D. in Mathematics, August 2011. *Thesis advisor:* Tatiana Toro.
- M.S. in Mathematics, August 2008.

#### UNIVERSITY OF PITTSBURGH

- B.S. in Mathematics, April 2006.
- B.A. in Political Science, April 2006.

### Research Interests

My main research focus is on the **Geometry of Sets and Measures** that appear in various types of classical analysis. I am especially interested in problems from geometric measure theory and in higher-dimensional (3D+) analogues of geometric function theory in the complex plane (2D).

#### BUZZWORDS

*Geometric Measure Theory, Rectifiability, Harmonic Measure, Elliptic PDE in Rough Domains, Lipschitz and Hölder Parameterizations, Modulus of Measures, AND Quasiconformal Maps*

### Research Grants, Fellowships, Awards

- NSF 2154047, “Rectifiability and Fine Geometry of Sets, Radon Measures, Harmonic Functions, and Temperatures”, 2022–2025, \$278,485
- NSF 1650546, “CAREER: Analysis and Geometry of Measures”, 2017–2022, \$410,000
- NSF 1500382, “Geometry of Sets and Measures”, 2015–2018, \$120,000
- NSF Mathematical Sciences Postdoctoral Research Fellowship, 2012–2015, \$150,000
- RTG Graduate Fellowship, Inverse Problems & PDE, University of Washington, 2009–2010 and 2010–2011.
- VIGRE Graduate Fellowship, University of Washington, 2006–2007.

- M.M. Culver Award, University of Pittsburgh, 2004, 2005 and 2006: prize awarded annually to outstanding undergraduates majoring in mathematics.

### Conference Grants

- NSF 1901256, “Collaborative Research: The Northeast Analysis Network”, 2019–2023, \$10,305

### Thesis Students

#### THESIS ADVISOR FOR:

- **Lisa Naples** (supervised 2016–2020), Ph.D. Summer 2020. Fall 2020–Spring 2023: Visiting Assistant Professor at Macalester College in St. Paul, Minnesota.

#### COMMITTEE MEMBER FOR:

- **Marco Carfagnini**, Ph.D. Summer 2022, Starting in Fall 2022: Stefan E. Warschawski Visiting Assistant Professor at University of California, San Diego

### Graduate Research Assistants Funded

- **Zackary Boone**, Summer 2023
- **Christopher Hayes**, Fall 2021
- **Erik Wendt**, Fall 2020
- **Lisa Naples**, Fall 2017, Fall 2018, Fall 2019

### Postdoctoral Fellows

- **Alyssa Genschaw**, Visiting Assistant Professor at UConn, 2019–2021. Starting in Fall 2021, Assistant Professor at Milwaukee School of Engineering.
- **Murat Akman**, Evarist Gine Postdoctoral Fellow at UConn, 2016–2019. Awarded AMS-Simons travel grant in 2018. Starting in Fall 2019, Lecturer at University of Essex, UK.
- **Vyron Vellis**, Postdoctoral Fellow at UConn, 2016–2019. Awarded NSF grant as a postdoc at UConn in 2018. Starting in Fall 2019, Assistant Professor at University of Tennessee.

### Publications (ordered by arXiv number / date of first availability)

1. Harmonic polynomials and tangent measures of harmonic measure, *Rev. Mat. Iberoam.* **27** (2011), no. 3, 841–870. arXiv:0910.2591
2. Null sets of harmonic measure on NTA domains: Lipschitz approximation revisited, *Math. Z.* **270** (2012), no. 1–2, 241–262. arXiv:1003.4547
3. Flat points in zero sets of harmonic polynomials and harmonic measure from two sides, *J. London Math. Soc.* **87** (2013), no. 1, 111–137. arXiv:1109.1427
4. (with James T. Gill, Steffen Rohde and Tatiana Toro) Quasisymmetry and rectifiability of quasispheres, *Trans. Amer. Math. Soc.* **366** (2014), no. 3, 1413–1431. arXiv:1201.1581
5. Beurling’s criterion and extremal metrics for Fuglede modulus, *Ann. Acad. Sci. Fenn. Math.* **38** (2013), 677–689. arXiv:1207.5277
6. (with Raanan Schul) Multiscale analysis of 1-rectifiable measures: necessary conditions, *Math. Ann.* **361** (2015), no. 3–4, 1155–1172. arXiv:1307.0804
7. (with Jonas Azzam and Tatiana Toro) Quasiconformal planes with bi-Lipschitz pieces and extensions of almost affine maps, *Adv. Math.* **275** (2015), 195–259. arXiv:1403.2991

8. (with Stephen Lewis) Local set approximation: Mattila-Vuorinen type sets, Reifenberg type sets, and tangent sets, *Forum Math. Sigma* **3** (2015), e24, 63 pp. arXiv:1409.7851
9. (with Raanan Schul) Two sufficient conditions for rectifiable measures, *Proc. Amer. Math. Soc.* **144** (2016), no. 6, 2445–2454. arXiv:1412.8357
10. (with Murat Akman, Steve Hofmann, and José María Martell) Rectifiability and elliptic measures on 1-sided NTA domains with Ahlfors-David regular boundaries. *Trans. Amer. Math. Soc.* **369** (2017), no. 8, 5711–5745. arXiv:1507.02039
11. (with Max Engelstein and Tatiana Toro) Structure of sets which are well approximated by zero sets of harmonic polynomials, *Anal. PDE.* **10** (2017), no. 6, 1455–1495. arXiv:1509.03211
12. (with Raanan Schul) Multiscale analysis of 1-rectifiable measures II: characterizations. *Anal. Geom. Metr. Spaces* **5** (2017), no. 1, 1–39. arXiv:1602.03823
13. (with Vyron Vellis) Geometry of measures in real dimensions via Hölder parameterizations. *J. Geom. Anal.* **29** (2019), no. 2, 1153–1192. arXiv:1706.07846
14. Generalized rectifiability of measures and the identification problem. *Complex Analysis and its Synergies* **5** (2019), 2. doi:10.1007/s40627-019-0027-3 arXiv:1803.10022
15. (with Lisa Naples and Vyron Vellis) Hölder curves and parameterizations in the Analyst’s Traveling Salesman theorem. *Adv. Math.* **349** (2019), 564–647. doi:10.1016/j.aim.2019.04.011 arXiv:1806.01197
16. (with Max Engelstein, Tatiana Toro) Regularity of the singular set in a two-phase problem for harmonic measure with Hölder data. *Rev. Mat. Iberoam.* **36** (2020), no. 5, 1375–1408. doi:10.4171/rmi/1170 arXiv:1807.08002
17. (with Vyron Vellis) Hölder parameterization of iterated function systems and a self-affine phenomenon. *Anal. Geom. Metr. Spaces* **9** (2021), 90–119. doi:10.1515/agms-2020-0125 arXiv:1910.08850
18. (with Sean McCurdy) Subsets of rectifiable curves in Banach spaces I: sharp exponents in traveling salesman theorems. *Illinois J. Math.* **67** (2023), no. 2, 203–274. doi:10.1215/00192082-10592363 arXiv:2002.11878v3
19. (with Lisa Naples) Radon measures and Lipschitz graphs. *Bull. London Math. Soc.* **53** (2021), no. 3, 921–936. doi:10.1112/blms.12473 arXiv:2007.08503
20. (with Sean McCurdy) Subsets of rectifiable curves in Banach spaces II: universal estimates for almost flat arcs. *Illinois J. Math.* **67** (2023), no. 2, 275–331. doi:10.1215/00192082-10592390 arXiv:2208.10288
21. A practical guide to writing an NSF grant proposal, *Notices Amer. Math. Soc.* **70** (2023), no. 7, 1089–1093. doi:10.1090/noti2729

## ACCEPTED FOR PUBLICATION

22. (with Alyssa Genschaw) Hausdorff dimension of caloric measure. To appear in *Amer. J. Math.* Accepted July 2023. arXiv:2108.12340
23. (with Sean Li and Scott Zimmerman) Identifying 1-rectifiable measures in Carnot groups. To appear in *Anal. Geom. Metr. Spaces.* Accepted August 2023. arXiv:2109.06753v4
24. (with Max Engelstein and Tatiana Toro) Slowly vanishing mean oscillations: non-uniqueness of blow-ups in a two-phase free boundary problem. To appear in *Vietnam J. Math.* Accepted July 2023. arXiv:2210.17531

## PREPRINTS

25. (with Alyssa Genschaw) Lower bounds on Bourgain’s constant for harmonic measure. Preprint. arXiv:2205.15101v2

26. (with Raanan Schul) Square packings and rectifiable doubling measures. Preprint. arXiv:2309.01283

### Plenary Talks

- “Open Problems about Curves, Sets, and Measures”. 8th Ohio River Analysis Meeting. Lexington, Kentucky. March 2018.

### Other Invited Research Talks (*reverse chronological order*)

- Calderón-Zygmund Seminar. University of Chicago. Chicago, Illinois. January 2023.
- Math Seminar. Montana State University. Bozeman, Montana. October 2022.
- AMS special session on Nonsmooth Analysis and Geometry. Eastern section. Amherst, Massachusetts. October 2022.
- Analysis and Probability Seminar. UConn. Storrs, Connecticut. September 2022.
- Conference. Geometry and Analysis on Nonsmooth Spaces. Texas A&M. August 2022.
- CBMS conference: Analysis, Geometry, and PDEs in a Lower-Dimensional World. FSU. Tallahassee, Florida. May 2022 (Originally August 2020, Delayed due to Covid-19)
- Harmonic analysis and PDE conference. Yonsei University. Seoul, South Korea. May 2022. (Originally scheduled May 2020. Delayed due to Covid-19. Declined invitation.)
- AMS Special Session on Geometric Measure Theory. J. Math. Meet. Online. April 2022. (Originally scheduled January 2022. Delayed due to Covid-19. Declined invitation.)
- Calderón-Zygmund Seminar. University of Chicago. Virtual. May 2021.
- AMS Special Session on Nonsmooth Analysis and Geometry. Virtual Central Sectional Meeting. April 2021.
- Elliptic PDEs and Geometric Variational Problems. 13th AIMS conference on Dyn. Sys., Diff. Eqs. and Appl. Atlanta, Georgia. June 2020. (Cancelled due to Covid-19)
- BIRS Workshop. Analysis and Geometry of Metric Spaces - a Bridge between Smooth and Fractal Views. Banff, Canada. April 2020. (Cancelled due to Covid-19)
- AMS special session on Harmonic Analysis. Southeastern Sectional Meeting. Charlottesville, Virginia. March 2020. (Cancelled due to Covid-19)
- Special Session on Interfaces between PDEs and Geometric Measure Theory. Joint Mathematics Meetings. Denver, Colorado. January 2020.
- Colloquium. Kansas State University. Manhattan, Kansas. November 2019.
- Function theory seminar. Kansas State University, Manhattan, Kansas. November 2019.
- Geometry and analysis in function and mapping theory on Euclidean and metric measure spaces. Banach Center. Poland. October 2019.
- AMS special session on Analysis and Probability on Metric Spaces and Fractals. Central Sectional Meeting. Madison, Wisconsin. September 2019.
- Rainwater seminar. University of Washington. Seattle, Washington. February 2019.
- AMS special session on Harmonic Analysis, Partial Differential Equations, and Applications. Joint Mathematics Meeting. Baltimore, Maryland. January 2019.
- AMS special session on Harmonic Analysis and PDE. Southeastern Sectional Meeting. Fayetteville, Arkansas. November 2018.
- Research program seminar. PCMI Harmonic Analysis. Park City, Utah. July 2018.
- Rainwater seminar. University of Washington, Seattle, Washington. May 2018.

- AMS special session on Analysis and Geometry in Non-smooth Spaces. Eastern Sectional Meeting. Boston, Massachusetts. April 2018.
- AMS special session on Regularity of PDEs in Rough Domains. Eastern Sectional Meeting. Boston, Massachusetts. April 2018.
- AMS special session on Analysis at the Intersection of Geometric Measure Theory and Partial Differential Equations. Western Sectional Meeting. Portland, Oregon. April 2018.
- Analysis and PDE seminar. University of Kentucky. Lexington, Kentucky. March 2018.
- 3rd Northeast Analysis Network Meeting. Syracuse, New York. September 2017.
- Geometric Measure Theory conference. Warwick, United Kingdom. July 2017.
- Harmonic analysis seminar. MSRI. Berkeley, California. March 2017.
- Conference on “Analysis on Metric Spaces.” University of Pittsburgh. March 2017.
- Analysis seminar. Brown University. Providence, RI. October 2016.
- Analysis and PDE seminar. University of Cincinnati. Cincinnati, Ohio. April 2016.
- Rainwater seminar. University of Washington. Seattle, Washington. March 2016.
- Analysis and probability seminar. University of Connecticut. Storrs. March 2016.
- AMS Special Session on Analysis and Geometry in Nonsmooth Metric Measure Spaces. Joint Mathematics Meetings. Seattle, Washington. January 2016.
- Minisymposium, “New Trends in Elliptic and Parabolic PDEs” SIAM conference—Analysis of PDE. Scottsdale, Arizona. December 2015.
- Rainwater seminar. University of Washington. Seattle, Washington. May 2015.
- Analysis seminar. Brown University. Providence, Rhode Island. April 2015.
- Analysis seminar. University of Missouri. Columbia, Missouri. April 2015.
- Colloquium. Worcester Polytechnic Institute. Worcester, Massachusetts. March 2015.
- Geometry seminar. University of Jyväskylä. Jyväskylä, Finland. February 2015.
- Geometric analysis seminar. University of Helsinki. Helsinki, Finland. February 2015.
- Analysis seminar. Fordham University. Bronx, New York. November 2014.
- Ahlfors-Bers Colloquium VI. Yale University. New Haven, Connecticut. October 2014.
- Analysis and probability seminar. University of Connecticut. Storrs. September 2014.
- Dynamical systems seminar. Stony Brook University and the Institute for Mathematical Sciences. Stony Brook, New York. May 2014.
- Colloquium. University of Connecticut. Storrs, Connecticut. January 2014.
- Rainwater seminar. University of Washington. Seattle, Washington. January 2014.
- Analysis seminar. University of Illinois, Urbana-Champaign. November 2013.
- Analysis seminar. Syracuse University. Syracuse, New York. October 2013.
- AMS Special Session on Harmonic Analysis and Partial Differential Equations. Louisville, Kentucky. October 2013.
- AMS Special Session on Analysis, Dynamics and Geometry in and around Teichmüller spaces. Ames, Iowa. April 2013.
- Analysis seminar. Temple University. Philadelphia, Pennsylvania. February 2013.
- Complex analysis seminar. University of Washington. Seattle. January 2013.
- Perspectives in HA, GMT, and PDE, and their applications to SCV. Temple University. Philadelphia, Pennsylvania. September 2012.
- Simons Postdoctoral Fellows Meeting. Simons Center for Geometry and Physics. Stony Brook, New York. April 2012.
- Complex analysis seminar. University of Washington. Seattle. January 2012.

- Dynamical systems seminar. Stony Brook University and the Institute for Mathematical Sciences. Stony Brook, New York. September 2011.
- AMS Special Session on Geometric Aspects of Analysis and Measure Theory. Eastern Sectional Meeting. Ithaca, New York. September 2011.
- AMS Special Session on Harmonic Analysis and PDE. Joint Mathematics Meetings. New Orleans, Louisiana. January 2011.
- Analysis seminar. Brown University. Providence, RI. December 2010.
- Harmonic analysis seminar. Université Paris-Sud XI. Orsay, France. April 2010.
- Rainwater seminar. University of Washington. Seattle, Washington. February 2010.
- Harmonic analysis conference. Centre de Recerca Matemàtica (CRM). Bellaterra, Spain. June 2009.
- Rainwater seminar. University of Washington. Seattle, Washington. May 2009.

#### UPCOMING INVITED TALKS

- PDE Seminar. University of Minnesota. Minneapolis, MN. October 2023.
- Colloquium. University of Tennessee. Knoxville, TN. February 2024.
- Conference. University of Arkansas Spring Lecture Series. Fayetteville, AR. May 2024.
- Conference. “PDE in Moab”. Utah. June 2024.

#### Invited Mini Courses

- *Introduction to Geometry of Sets and Measures*, 3 lectures,  $4\frac{1}{2}$  hours. Progress in Harmonic Analysis and Geometric Measure Theory. Temple University. April 2014.

#### Professional Activities

- Organizer: Geometry of Measures and Free Boundaries. A conference in honor of Tatiana Toro. Seattle, Washington. July 22–26, 2024. Pre-conference mini-courses to be held before the conference. Co-organized with Mariana Smit Vega Garcia, Stefan Steinerberger, Bobby Wilson.
- Co-organizer of the 2022 Northeast Analysis Network Conference at SUNY Albany. September 2022. *This regional conference series is a joint venture with SUNY Albany, Syracuse University, and University of Rochester.*
- Co-organizer (with Guy C. David and Lisa Naples): AMS Special Session in Geometry of Measures and Metric Spaces. Spring Central Section Meeting. Online. March 2022. (Originally at Purdue University, Covid-19 impacted)
- Co-organizer and Local Organizer of the 2019 Northeast Analysis Network Conference at UConn Storrs Campus. September 2019. *This regional conference series is a joint venture with SUNY Albany, Syracuse University, and University of Rochester.*
- Local organizer for AMS Eastern Sectional Meeting. Hartford, Connecticut. April 2019. *As the Local Organizer, I ensured smooth logistics at the UConn Hartford conference site, securing space for 20+ parallel sessions and plenary talks, 400+ participants, catering, and facilitating communication and coordination of staff from UConn and the American Mathematical Society. Planning started over 18 months in advance of the event.*
- Organizer of “Geometric and Harmonic Analysis: a Conference for Graduate Students”. University of Connecticut. March 2019. Co-organized with Murat Akman, Vyron Vellis. Website at: <https://gaha2019.math.uconn.edu/>

- Organizer of “Nonsmooth Analysis: a Workshop for Postdocs”. University of Connecticut. November 2017. Website at: <https://nonsmooth2017.math.uconn.edu/>
- Co-organizer (with Vasileios Chousionis): AMS Special Session in Geometric Aspects of Harmonic Analysis. Fall Eastern Sectional Meeting. Brunswick, Maine. September 2016.
- Co-organizer (with Chris Bishop and Raanan Schul): AMS Special Session in Geometric Measure Theory and Its Applications. Spring Eastern Sectional Meeting. Stony Brook, New York. March 2016.
- Chair of organizing committee for the UConn Special Semester in Nonsmooth Analysis. University of Connecticut. Department of Mathematics. Fall 2015. Co-organized with Vasileios Chousionis, Masha Gordina, Luke Rogers, and Sasha Teplyaev.
- Co-organizer (with Jim Gill and Joan Lind): AMS Special Session in Complex Analysis, Probability and Metric Geometry. Spring Southeastern Sectional Meeting. Knoxville, Tennessee. March 2014.
- Co-organizer (with Theresa Anderson, Nathan Pennington, Eric Stachura): AMS Special Session in Harmonic Analysis, PDE, and Geometric Measure Theory. Joint Mathematics Meetings. San Diego. January 2013.
- TA for Summer Graduate Courses in Geometric Measure Theory. MSRI. July 2011.
- Organized a series of “Professional Development Sessions” for the mathematics graduate students at University of Washington, 2010 – 2011.
- Served on 4 NSF Review Panels and as an ad-hoc reviewer.
- Ad-hoc reviewer for European Research Council.
- Reviewed book manuscripts for Springer.
- Refereed papers for multiple research journals, including
  - ▷ Adv. Math. ▷ Amer. J. Math. ▷ Anal. Acad. Sci. Fenn. Math. ▷ Anal. PDE
  - ▷ Ann. Sci. Éc. Norm. Supér. ▷ Arch. Math. (Basel) ▷ Chaos Solitons & Fractals
  - ▷ Duke Math. J. ▷ Geom. Func. Anal. ▷ Forum Math. Sigma
  - ▷ Int. Math. Res. Not. IMRN ▷ Invent. Math. ▷ J. Amer. Math. Soc.
  - ▷ J. Anal. Math. ▷ J. Eur. Math. Soc. (JEMS) ▷ J. Fourier Anal. Appl. ▷ J. Func. Anal.
  - ▷ J. Geom. Anal. ▷ J. London Math. Soc. ▷ Mathematika ▷ Math. Ann.
  - ▷ Michigan Math. J. ▷ Memoirs Amer. Math. Soc. ▷ Nonlinear Anal.
  - ▷ Proc. Amer. Math. Soc. ▷ Proc. London Math. Soc. ▷ Rev. Mat. Iberoam.
  - ▷ Trans. Amer. Math. Soc. ▷ Vietnam J. Math.
- Reviewer for *Mathematical Reviews*, 27 reviews, 2012–2017.

## Selected Service

### UNIVERSITY OF CONNECTICUT

- General Education Oversight Committee, Subcommittee on Q (Quantitative) Courses, Fall 2021 – *present*

### UConn DEPARTMENT OF MATHEMATICS

- Analysis Learning Seminar, Founder and Organizer, multiple semesters
- Analysis & Probability Seminar, Organizer, multiple semesters
- Initial advisor for incoming Ph.D. students, multiple years
- Graduate Admissions Committee, Spring 2017, Spring 2020, Spring 2023
- Graduate Admissions Co-Chair, Fall 2017 – Spring 2018
- Graduate Program Committee, Fall 2015 – Spring 2018

- VAP Search Committee, Spring 2015

## Teaching Experience

### UNIVERSITY OF CONNECTICUT

#### Graduate Courses

- Math 5440 Partial Differential Equations **Fall 2023**
- Math 5140 Fourier Analysis **Fall 2022**
- Math 5120 Complex Analysis **Spring 2020**
- Math 5010 Topics in Analysis: Geometric Measure Theory **Fall 2018**
- Math 5111 Measure Theory & Integration **Spring 2018**
- Math 5120 Complex Analysis **Spring 2016**
- Math 5110 Introduction to Modern Analysis **Fall 2015**
- Math 5110 Introduction to Modern Analysis **Fall 2014**

#### Undergraduate Courses – Math Majors

- Math 3151 Analysis II **Spring 2022**
- Math 3370 Differential Geometry **Fall 2021**
- Math 3150 Analysis I **Fall 2021**
- Math 3210 Abstract Linear Algebra **Spring 2021**
- Math 2710W Transitions to Advanced Mathematics **Spring 2019**
- Math 3151 Analysis II **Spring 2019**
- Math 3150 Analysis I **Fall 2017**
- Math 3150 Analysis I **Fall 2016**
- Math 4110 Introduction to Modern Analysis **Fall 2015**
- Math 4110 Introduction to Modern Analysis **Fall 2014**

#### Undergraduate Courses – Service Courses

- Math 2210Q ~ Applied Linear Algebra **Fall 2023**
- Math 2210Q Applied Linear Algebra (2 sections) **Spring 2023**
- Math 2210Q Applied Linear Algebra (Honors) **Spring 2021**
- Math 2210Q Applied Linear Algebra (2 sections) **Fall 2019**
- Math 2410 Elementary Differential Equations **Fall 2016**
- Math 2410 Elementary Differential Equations **Spring 2016**
- Math 1131 Calculus I **Summer 2015**

### STONY BROOK UNIVERSITY

#### Graduate Courses

- Math 550 Real Analysis II **Spring 2014**
- Math 638 Topics in Real Analysis: Brownian Motion and Harmonic Measure **Fall 2013**

#### Undergraduate Courses – Math Majors

- Math 322 Analysis in Several Dimensions **Spring 2012**

#### Undergraduate Courses — Service Courses

- Math 211 Introduction to Linear Algebra **Fall 2012**
- Math 125 Calculus A (Differential Calculus) **Fall 2011**
- Math 126 Calculus B (Integral Calculus) **Fall 2011**



In Fall 2012, I also directed two independent studies by undergraduate math majors on  
▷ Harmonic Function Theory ▷ Analysis on Manifolds.

UNIVERSITY OF WASHINGTON

Undergraduate Courses — Service Courses

- Math 309 Linear Analysis
- Math 308 Matrix Algebra with Applications
- Math 308 Matrix Algebra with Applications

**Fall 2010**  
**Winter 2010**  
**Summer 2008**