

# References

- Bahlo, M., Griffiths, R.C.: Coalescence time for two genes from a subdivided population. *J. Math. Biol.* **43**, 397–410 (2001)
- Baird, S.J.E., Barton, N.H., Etheridge, A.M.: The distribution of surviving blocks of ancestral genome. *Theor. Popul. Biol.* **64**, 451–471 (2003)
- Barton, N.H.: The effect of hitch-hiking on neutral genealogies. *Gen. Res.* **72**, 123–133 (1998)
- Barton, N.H., Briggs, D.E.G., Eisen, J.A., Goldstein, D.B., Patel, N.H.: *Evolution*. Cold spring Harbour Press, New York, (2007)
- Barton, N.H., Depaulis, F., Etheridge, A.M.: Neutral evolution in spatially continuous populations. *Theor. Popul. Biol.* **61**, 31–48 (2002)
- Barton, N.H., Etheridge, A.M., Sturm, A.K.: Coalescence in a random background. *Ann. Appl. Probab.* **14**(2), 754–785 (2004)
- Barton, N.H., Etheridge, A.M., Véber, A.: A new model for evolution in a spatial continuum. *Electron. J. Probab.* **15**, 162–216 (2010)
- Barton, N.H., Kelleher, J., Etheridge, A.M.: A new model for extinction and recolonization in two dimensions: quantifying phylogeography. *Evolution* (2010)
- Berestycki, J., Berestycki, N., Schweinsberg, J.: Beta-coalescents and continuous stable random trees. *Ann. Probab.* **35**(5), 1835–1887 (2007)
- Berestycki, N.: Recent progress in coalescent theory. *Ensaios Matemáticos* **16** (2009)
- Berestycki, N., Etheridge, A.M., Hutzenthaler, M.: Survival, extinction and ergodicity in a spatially continuous population model. *Markov Process. Relat. Fields* **15**(3), 265–288 (2009)
- Bertoin, J., Le Gall, J.-F.: Stochastic flows associated to a coalescent process. *Prob. Theor. Relat. Fields* **126**, 261–288 (2003)
- Birkner, M., Blath, J.: Computing likelihoods for coalescents with multiple collisions in the infinitely-many-sites model. *J. Math. Biol.* **57**, 435–465 (2008)
- Birkner, M., Blath, J., Capaldo, M., Etheridge, A.M., Möhle, M., Schweinsberg, J., Wakolbinger, A.: Alpha-stable branching and Beta-coalescents. *Elect. J. Probab.* **10**, 303–325 (2005)
- Buri, P.: Gene frequency in small populations of mutant *Drosophila*. *Evolution* **10**, 367–402 (1956)
- Chang, J.T.: Recent common ancestors of all present day individuals. *Adv. Appl. Probab.* **31**, 1002–1026 (1999)
- Darden, T., Kaplan, N.L., Hudson, R.B.: A numerical method for calculating moments of coalescence times in finite populations with selection. *J. Math. Biol.* **27**(3), 355–368 (1989)
- Darwin, C.: On the origin of species by means of natural selection. John Murray, London (1859)
- Dawson, D.A.: Measure-valued Markov processes. *École d’été de probabilités de Saint Flour*, vol. 1541, Springer, Berlin (1993)
- Donnelly, P.J., Kurtz, T.G.: A countable representation of the Fleming-Viot measure-valued diffusion. *Ann. Probab.* **24**, 698–742 (1996)
- Donnelly, P.J., Kurtz, T.G.: Particle representations for measure-valued population models. *Ann. Probab.* **27**, 166–205 (1999)
- Durrett, R.: *Stochastic calculus. A practical introduction*, CRC, Boca Raton, (1996)

- Durrett, R., Schweinsberg, J.: Approximating selective sweeps. *Theor. Popul. Biol.* **66**(2), 129–138 (2004)
- Durrett, R., Schweinsberg, J.: A coalescent model for the effect of advantageous mutations on the genealogy of a population. *Stoch. Proc. Appl.* **115**(10), 1628–1657 (2005)
- Eldon, B., Wakeley, J.: Coalescent processes when the distribution of offspring number among individuals is highly skewed. *Genetics* **172**, 2621–2633 (2006)
- Etheridge, A., Pfaffelhuber, P., Wakolbinger, A.: An approximate sampling formula under genetic hitchhiking. *Ann. Appl. Probab.* **16**(2), 685–729 (2006)
- Etheridge, A.M.: An introduction to superprocesses. University lecture notes, vol. 20. Am. Math. Soc., Providence (2000)
- Etheridge, A.M., Griffiths, R.C.: A coalescent dual process in a Moran model with genic selection. *Theor. Popul. Biol.* **75**, 320–330 (2009)
- Ethier, S.N., Kurtz, T.G.: Markov processes: characterization and convergence. Wiley, New York (1986)
- Ewens, W.J.: The sampling theory of selectively neutral alleles. *Theor. Popul. Biol.* **3**, 87–112 (1972)
- Ewens, W.J.: The concept of the effective population size. *Theor. Popul. Biol.* **21**, 373–378 (1982)
- Ewens, W.J.: Mathematical population genetics i. theoretical introduction. Springer, New York (2004)
- Feller, W.: Diffusion processes in genetics. *Proc. Second Berkeley Symp.* 227–246 (1951)
- Feller, W.: Two singular diffusion problems. *Ann. Math.* **54**, 173–182 (1951)
- Felsenstein, J.: A pain in the torus: some difficulties with the model of isolation by distance. *Am. Nat.* **109**, 359–368 (1975)
- Fisher, R.A.: The correlation between relatives on the supposition of Mendelian inheritance. *Proc. Roy. Soc. Edinburgh* **52**, 399–433 (1918)
- Griffiths, R.C.: Ancestral inference from gene trees. In: Slatkin, M., Veuille, M. (eds.) *Modern developments in theoretical population genetics: the legacy of Gustave Malécot*. Oxford University Press, Oxford (2002)
- Haldane, J.B.S.: A mathematical theory of natural and artificial selection. A series of papers beginning in 1924 (1924)
- Haldane, J.B.S.: The causes of evolution. Longman, Green and Co., New York (1932)
- Kaj, I., Krone, S.M.: The coalescent process in a population with stochastically varying size. *J. Appl. Prob.* **40**, 33–48 (2003)
- Karlin, S., Taylor, H.M.: A second course in stochastic processes. Academic Press, New York (1981)
- Kimura, M.: Stepping stone model of population. *Ann. Rep. Nat. Inst. Genet. Jpn.* **3**, 62–63 (1953)
- Kimura, M.: Evolutionary rate at the molecular level. *Nature* **217**, 624–626 (1968)
- Kimura, M.: The neutral theory of molecular evolution. Cambridge University Press, Cambridge (1983)
- Kingman, J.F.C.: Random discrete distributions. *J. R. Stat. Soc. B* **37**, 1–22 (1975)
- Kingman, J.F.C.: The population structure associated with the Ewens sampling formula. *Theor. Popul. Biol.* **11**, 274–283 (1977)
- Kingman, J.F.C.: The coalescent. *Stoch. Proc. Appl.* **13**, 235–248 (1982)
- Knight, F.B.: Essentials of Brownian motion and diffusion. Mathematical surveys, vol. 18. Am. Math. Soc., Providence (1981)
- Krone, S.M., Neuhauser, C.: Ancestral processes with selection. *Theor. Popul. Biol.* **51**, 210–237 (1997)
- Limic, V., Sturm, A.: The spatial Lambda-coalescent. *Electron. J. Probab.* **11**(15), 363–393 (2006)
- Lynch, M., Conery, J.S.: The origins of genome complexity. *Science* **302**, 1401–1404 (2003)
- Malécot, G.: *Les mathématiques de l'hérédité*. Masson et Cie, Paris (1948)
- Mendel, G.: Versucher über Pflanzenhybriden. *Verhandlungen des naturforschenden Vereines in Brünn Bd. IV für das Jahr, 1865*, 3–47 (1866)
- Möhle, M.: A convergence theorem for Markov chains arising in population genetics and the coalescent with selfing. *Adv. Appl. Prob.* **30**, 493–512 (1998)

- Möhle, M.: Total variation distances and rates of convergence for ancestral coalescent processes in exchangeable population models. *Adv. Appl. Prob.* **32**, 983–993 (2000)
- Möhle, M., Sagitov, S.: A classification of coalescent processes for haploid exchangeable models. *Ann. Probab.* **29**, 1547–1562 (2001)
- Moran, P.A.P.: Random processes in genetics. *Proc. Camb. Phil. Soc.* **54**, 60–71 (1958)
- Nagylaki, T.: A diffusion model for geographically structured populations. *J. Math. Biol.* **6**, 375–382 (1978)
- Nagylaki, T.: Random genetic drift in a cline. *Proc. Nat. Acad. Sci. USA* **75**, 423–426 (1978)
- Neuhauser, C., Krone, S.M.: Genealogies of samples in models with selection. *Genetics* **145**, 519–534 (1997)
- Nordborg, M., Donnelly, P.: The coalescent process with selfing. *Genetics* **146**, 1185–1195 (1997)
- Nordborg, M., Krone, S.M.: Separation of timescales and convergence to the coalescent in structured populations. In: Slatkin, M., Veuille, M. (eds.) *Modern developments in theoretical population genetics: the legacy of Gustave Malécot*. Oxford University Press, Oxford (2002)
- Pitman, J.: Coalescents with multiple collisions. *Ann. Probab.* **27**, 1870–1902 (1999)
- Sagitov, S.: The general coalescent with asynchronous mergers of ancestral lines. *J. Appl. Probab.* **26**, 1116–1125 (1999)
- Sargsyan, O., Wakeley, J.: A coalescent processes with simultaneous multiple mergers for approximating the gene genealogies of many marine organisms. *Theor. Popul. Biol.* **74**, 104–114 (2008)
- Schweinsberg, J.: Coalescents with simultaneous multiple collisions. *Electron. J. Probab.* **5**, 1–50 (2000)
- Schweinsberg, J.: Coalescents obtained from supercritical Galton-Watson processes. *Stoch. Proc. Appl.* **106**, 107–139 (2003)
- Schweinsberg, J., Durrett, R.: Random partitions approximating the coalescence of lineages during a selective sweep. *Ann. Appl. Probab.* **15**(3), 1591–1651 (2005)
- Shiga, T.: Stepping stone models in population genetics and population dynamics. In: Alberverio, S., et al. (eds.) *Stochastic processes in physics and engineering*. D Reidel Publishing Company, Dordrecht (1988)
- Sjödin, P., Kaj, I., Krone, S., Lascoux, M., Nordborg, M.: On the meaning and existence of an effective population size. *Genetics* **169**, 1061–1070 (2005)
- Stroock, D.W., Varadhan, S.R.S.: *Multidimensional diffusion processes*. Springer, Berlin (1979)
- Taylor, J.E.: The genealogical consequences of fecundity variance polymorphism. *Genetics* **182**(3), 813–837 (2009)
- Wakeley, J.: The coalescent in an island model of population subdivision with variation among demes. *Theor. Popul. Biol.* **59**, 133–144 (2001)
- Wakeley, J., Aliacar, N.: Gene genealogies in a metapopulation. *Genetics* **159**, 893–905 (2001)
- Walsh, J.B.: *An introduction to stochastic partial differential equations*. École d'été de probabilités de Saint Flour, vol. 1180. Springer, New York (1986)
- Watanabe, H., Motoo, M.: Ergodic property of recurrent diffusion processes. *J. Math. Soc. Jpn.* **10**, 271–286 (1958)
- Watterson, G.A.: Reversibility and the age of an allele II. Two-allele models with selection and mutation. *Theor. Popul. Biol.* **12**(2), 179–196 (1977)
- Wilkins, J.F.: A separation of timescales approach to the coalescent in a continuous population. *Genetics* **168**, 2227–2244 (2004)
- Wilkins, J.F., Wakeley, J.: The coalescent in a continuous, finite, linear population. *Genetics* **161**, 873–888 (2002)
- Wilkinson-Herbots, H.M.: Coalescence time and  $F_{ST}$  values in subdivided populations with symmetric structure. *Adv. Appl. Prob.* **35**, 665–690 (2003)
- Wright, S.: Isolation by distance. *Genetics* **28**, 114–138 (1943)
- Zähle, I., Cox, J.T., Durrett, R.: The stepping stone model ii: genealogies and the infinite sites model. *Ann. Appl. Probab.* **15**, 671–699 (2005)

# List of Participants

## 39<sup>th</sup> Probability Summer School, Saint-Flour, France

July 5–18, 2009

### Lecturers

Robert ADLER	Technion Inst. Technology, Haifa, Israel
Alison ETHERIDGE	University of Oxford, UK

### Participants

Mamadou BA	Univ. de Provence, Marseille, F
Vincent BANSAYE	Univ. Pierre et Marie Curie, Paris, F
David BASCOMPTE	Univ. Autònoma Barcelona, Spain
Mireia BESALÚ	Univ. Barcelona, Spain
Hermine BIERMÉ	Univ. Paris Descartes, F
Max BRUGGER	Oregon State University, Corvallis, USA
Valentina CAMMAROTA	Univ. Roma “Sapienza”, Italy
Alexandra CHRONOPOULOU	Purdue University, West Lafayette, USA
Charles CUTHBERTSON	Morgan Stanley, London, UK
François D’HAUTEFEUILLE	London, UK
Mirko D’OVIDIO	Univ. Roma “Sapienza”, Italy
Francisco Javier DELGADO	Univ. Barcelona, Spain
Yogeshwaran DHANDAPANI	École Normale Supérieure, Paris, F
Roland DIEHL	Univ. Orléans, F
Leif DÖRING	TU Berlin, Germany
Richard EDEN	Purdue University, West Lafayette, USA
Anne ESTRADE	Univ. Orléans, F
Mikael FALCONNET	Univ. J. Fourier, Grenoble, F
Benjamin FAVETTO	Univ. Paris Descartes, F
Antoine GERBAUD	Univ. J. Fourier, Grenoble, F

Raouf GHOMRASNI	African Inst. Math. Sciences, South Africa
Priscilla GREENWOOD	Arizona State University, Tempe, USA
Simona GRUSEA	Univ. de Provence, Marseille, F
M. O. HAJI MIRSADEGHI	École Normale Supérieure, Paris, F
Olivier HÉNARD	CERMICS, Marne-la-Vallée, F
Marie KRATZ	Univ. Paris Descartes, F
Krzysztof LATUSZYNSKI	Univ. Warwick, UK
Mickaël LAUNAY	Univ. de Provence, Marseille, F
Jean-François LE GALL	Univ. Paris-Sud, Orsay, F
Sophie LEMAIRE	Univ. Paris-Sud, Orsay, F
Philippe MARCHAL	École Normale Supérieure, Paris, F
Takahiro MARUKI	Arizona State University, Tempe, USA
Grégory MIERMONT	École Normale Supérieure, Paris, F
Alina NICOLAIE	Leiden Univ. Medical Center, NL
Bernardo NIPOTI	Univ. Pavia, Italy
Raoul NORMAND	Univ. Pierre et Marie Curie, Paris, F
Piotr NOWAK	Univ. Wroclaw, Poland
Janosch ORTMANN	Univ. Warwick, UK
Todd PARSONS	Univ. Pennsylvania, Philadelphia, USA
Jean PICARD	Univ. Blaise Pascal, Clermont-Ferrand, F
Balakrishna PRABHU	LAAS, Toulouse, F
Habib SAADI	Oxford Univ., UK
Majid SALAMAT	Univ. de Provence, Marseille, F
Laurent SERLET	Univ. Blaise Pascal, Clermont-Ferrand, F
Florian SIMATOS	INRIA Paris-Rocquencourt, F
Kinga SIPOS	Babes-Bolyai Univ., Cluj Napoca, Romania
Arno SIRI-JÉGOUSSE	Univ. Paris Descartes, F
Katharina SUROVCIK	Univ. Freiburg, Germany
Jonathan TAYLOR	Stanford Univ., USA
Marie THÉRET	École Normale Supérieure, Paris, F
Amandine VÉBER	Univ. Paris-Sud, Orsay, F
Juan VIQUEZ	Purdue University, West Lafayette, USA
Guillaume VOISIN	Univ. Orléans, F
Joseph ZADEH	Purdue University, West Lafayette, USA
Lorenzo ZAMBOTTI	Univ. Pierre et Marie Curie, Paris, F

## Programme of the School

### Main lectures

Robert Adler	Topological complexity of smooth random functions
Alison Etheridge	Some mathematical models from population genetics

### Short lectures

Vincent Bansaye	Large deviations for branching processes in random environment
David Bascompte	On the convergence toward two Gaussian processes constructed from a unique Poisson process
Hermine Biermé	Shot noise processes and crossings
Valentina Cammarota	Pseudo-processes: joint distribution of the pseudo-process and its sojourn time in $(0, +\infty)$
Alexandra Chronopoulou	Variations and Hurst index estimation for a Rosenblatt process using longer filters
Charles Cuthbertson	Fixation probability for competing selective sweeps
François d'Hautefeuille	Dimer model and Monte Carlo simulation
Yogeshwaran Dhandapani	Directionally convex ordering of random measures, shot-noise fields and some applications to wireless communications
Roland Diel	Local time of a diffusion in Brownian environment
Leif Döring	Longtime behaviour of symbiotic branching processes
Mikael Falconnet	Phylogenetic distances for neighbour dependent substitution processes
Benjamin Favetto	On the asymptotic variance in the central limit theorem for particle filters
Antoine Gerbaud	A random difference equation arising from a new model of stochastic network
Raouf Ghomrasni	Recent results on local time of semimartingales
Mir Omid Haji Mirsadeghi	First passage percolation in SINR random graph

Krzysztof Latuszyński	Simulating events of unknown probabilities via reverse time martingales
Philippe Marchal	Small time asymptotics for Lévy processes
Takahiro Maruki	A stochastic model of the hitchhiking effect
Grégory Miermont	Discrete splitting models and their scaling limits
Alina Nicolaie	Vertical modelling: a pattern mixture approach for competing risks modelling
Raoul Normand	A model for sexed coagulation
Todd Parsons	Some results for density dependent population genetics
Florian Simatos	Spatial homogenization in a stochastic network with mobility
Kinga Sipos	Optimization in cash management
Katharina Surovcik	Profiles for a class of binary random trees
Marie Thérét	Maximal flow through a domain of $R^d$ in first passage percolation
Amandine Véber	Branching Brownian motion among random obstacles
Guillaume Voisin	Fragmentation of a Lévy continuum random tree

# Index

## Symbols

$k$ -coalescent, 6  
 $\Lambda$ -Fleming-Viot process, 84  
    spatial, 104  
 $\Lambda$ -coalescent, 82  
    spatial, 105  
 $\Xi$ -coalescent, 83

## A

allele, 1  
allele frequency spectrum, 61  
ancestral selection graph, 73, 93

## B

base pair, 2, 3  
beta-coalescents, 85  
Brownian motion, 34  
    exit probabilities, 40

## C

càdlàg, 34  
Cannings model, 11  
chromosome, 3  
collecting phase, 99  
consistency, 7, 82  
crossover event, 78

## D

deme, 89  
diffusion, *see* one-dimensional diffusion  
diffusion approximation, 13  
diploid, 5  
Dirichlet distribution, 57  
DNA, 2  
dominance, 69

drift, 2, 5, 35  
duality, 91

## E

effective population size, 5, 8, 99, 106  
Ewens sampling formula, 62  
exchangeable, 11

## F

Feller's boundary classification, 41  
fitness, 65  
fixation, 7  
fixation probability, 68  
frequency spectrum, 59

## G

GEM distribution, 61  
gene, 1, 3  
gene diversity, 48  
gene tree, 17  
generator, 28  
genetic code, 2  
genetic drift, 2, 5, 35  
genetic hitchhiking, 82, 87  
genetic selection, 69  
Gillespie's pseudohitchhiking model, 87  
Green's function, 45

## H

haploid, 5  
heterozygosity, 16, 48, 56  
heterozygous effect, 69  
hitchhiking, 82, 87  
homozygosity, 56, 60



**I**

infinitely many alleles model, 16, 57  
 infinitely many sites model, 17  
 infinitesimal drift, 34  
 infinitesimal variance, 34  
 island model, 89, 95

**K**

Kimura's stepping stone model, *see* stepping stone model  
 Kingman coalescent, 6, 18, 83  
   random background, 77  
   variable population size, 75

**L**

locus, 3  
 lookdown process, 28

**M**

Möhle's lemma, 97  
 martingale problem, 35  
 modern evolutionary synthesis, 1  
 molecular clock, 2  
 Moran model, 23  
   with mutation, 24  
   with selection, 71  
 MRCA, 6  
 multiple mergers, 82  
   simultaneous, 83  
 mutation, 14, 24, 31  
   beneficial, 66  
   deleterious, 66  
   rates, 16

**N**

natural scale, 39  
 neighbourhood size, 101  
 neutral, 5  
 nucleotide, 3  
 nucleotide diversity, 16, 65

**O**

oldest allele, 51  
 one-dimensional diffusion, 33  
   exit probabilities, 41  
   Feller's boundary classification, 41

Green's function, 45  
 regularity, 47  
 scale function, 39  
 speed measure, 39  
   stationary distribution, 46  
 overdominance, 70

**P**

pain in the torus, 100, 102  
 panmictic, 5  
 parent-independent mutation, 16, 55  
 pedigree, 22  
 Poisson-Dirichlet distribution, 59  
 polymorphic, 16  
 probability generating functional, 58  
 probability of identity, 16  
 productlog function, 22

**R**

recombination, 78  
 regular, 47  
 relative fitness, 66  
 reversible  
   Markov chain, 50  
   diffusion, 50  
 RNA, 2

**S**

scale function, 39  
 scattering phase, 99  
 segregating site, 21  
 selection  
   genic, 69  
   overdominance, 70  
   underdominance, 70  
 selection coefficient, 66  
 selective sweep, 78  
 selfing, 13  
 shifting balance, 2  
 site, 3  
 site frequency spectrum, 25  
 SNP, 21  
 sojourn density, 45  
 spatial  $\Lambda$ -coalescent, 105  
 speed measure, 39  
 stationary distribution, 46  
 stepping stone model, 90  
   with selection, 92  
 structured coalescent, 91, 94  
 synonymous mutation, 14

**U**

ultimate common ancestor, 73  
underdominance, 70

**W**

Watterson's estimator, 21, 64  
weak selection limit, 68, 70, 71  
Wright's island model, *see* island model  
Wright–Fisher diffusion  
    exit times, 45  
    fixation probabilities, 68

multi-dimensional, 54  
stationary distribution, 48, 55  
stochastic differential equation, 8, 35  
with mutation, 32, 54  
with selection, 67

Wright–Fisher model, 5  
     $K$ -allele version, 53  
weak selection limit, 67  
with migration, 89  
with selection, 66, 75  
Wright–Malécot formula, 101

# Lecture Notes in Mathematics

For information about earlier volumes  
please contact your bookseller or Springer  
LNM Online archive: [springerlink.com](http://springerlink.com)

- Vol. 1824: J. A. Navarro González, J. B. Sancho de Salas,  $\mathcal{C}^\infty$  – Differentiable Spaces (2003)
- Vol. 1825: J. H. Bramble, A. Cohen, W. Dahmen, Multiscale Problems and Methods in Numerical Simulations, Martina Franca, Italy 2001. Editor: C. Canuto (2003)
- Vol. 1826: K. Dohmen, Improved Bonferroni Inequalities via Abstract Tubes. Inequalities and Identities of Inclusion-Exclusion Type. VIII, 113 p, 2003.
- Vol. 1827: K. M. Pilgrim, Combinations of Complex Dynamical Systems. IX, 118 p, 2003.
- Vol. 1828: D. J. Green, Gröbner Bases and the Computation of Group Cohomology. XII, 138 p, 2003.
- Vol. 1829: E. Altman, B. Gaujal, A. Hordijk, Discrete-Event Control of Stochastic Networks: Multimodularity and Regularity. XIV, 313 p, 2003.
- Vol. 1830: M. I. Gil', Operator Functions and Localization of Spectra. XIV, 256 p, 2003.
- Vol. 1831: A. Connes, J. Cuntz, E. Guentner, N. Higson, J. E. Kaminker, Noncommutative Geometry, Martina Franca, Italy 2002. Editors: S. Doplicher, L. Longo (2004)
- Vol. 1832: J. Azéma, M. Émery, M. Ledoux, M. Yor (Eds.), Séminaire de Probabilités XXXVII (2003)
- Vol. 1833: D.-Q. Jiang, M. Qian, M.-P. Qian, Mathematical Theory of Nonequilibrium Steady States. On the Frontier of Probability and Dynamical Systems. IX, 280 p, 2004.
- Vol. 1834: Yo. Yomdin, G. Comte, Tame Geometry with Application in Smooth Analysis. VIII, 186 p, 2004.
- Vol. 1835: O.T. Izhboldin, B. Kahn, N.A. Karpenko, A. Vishik, Geometric Methods in the Algebraic Theory of Quadratic Forms. Summer School, Lens, 2000. Editor: J.-P. Tignol (2004)
- Vol. 1836: C. Năstăsescu, F. Van Oystaeyen, Methods of Graded Rings. XIII, 304 p, 2004.
- Vol. 1837: S. Tavaré, O. Zeitouni, Lectures on Probability Theory and Statistics. Ecole d'Été de Probabilités de Saint-Flour XXXI-2001. Editor: J. Picard (2004)
- Vol. 1838: A.J. Ganesh, N.W. O'Connell, D.J. Wischik, Big Queues. XII, 254 p, 2004.
- Vol. 1839: R. Gohm, Noncommutative Stationary Processes. VIII, 170 p, 2004.
- Vol. 1840: B. Tsirelson, W. Werner, Lectures on Probability Theory and Statistics. Ecole d'Été de Probabilités de Saint-Flour XXXII-2002. Editor: J. Picard (2004)
- Vol. 1841: W. Reichel, Uniqueness Theorems for Variational Problems by the Method of Transformation Groups (2004)
- Vol. 1842: T. Johnsen, A. L. Knutsen,  $K_3$  Projective Models in Scrolls (2004)
- Vol. 1843: B. Jefferies, Spectral Properties of Noncommuting Operators (2004)
- Vol. 1844: K.F. Siburg, The Principle of Least Action in Geometry and Dynamics (2004)
- Vol. 1845: Min Ho Lee, Mixed Automorphic Forms, Torus Bundles, and Jacobi Forms (2004)
- Vol. 1846: H. Ammari, H. Kang, Reconstruction of Small Inhomogeneities from Boundary Measurements (2004)
- Vol. 1847: T.R. Bielecki, T. Björk, M. Jeanblanc, M. Rutkowski, J.A. Scheinkman, W. Xiong, Paris-Princeton Lectures on Mathematical Finance 2003 (2004)
- Vol. 1848: M. Abate, J. E. Fornæss, X. Huang, J. P. Rosay, A. Tumanov, Real Methods in Complex and CR Geometry, Martina Franca, Italy 2002. Editors: D. Zaitsev, G. Zampieri (2004)
- Vol. 1849: Martin L. Brown, Heegner Modules and Elliptic Curves (2004)
- Vol. 1850: V. D. Milman, G. Schechtman (Eds.), Geometric Aspects of Functional Analysis. Israel Seminar 2002-2003 (2004)
- Vol. 1851: O. Catoni, Statistical Learning Theory and Stochastic Optimization (2004)
- Vol. 1852: A.S. Kechris, B.D. Miller, Topics in Orbit Equivalence (2004)
- Vol. 1853: Ch. Favre, M. Jonsson, The Valuative Tree (2004)
- Vol. 1854: O. Saeki, Topology of Singular Fibers of Differential Maps (2004)
- Vol. 1855: G. Da Prato, P.C. Kunstmann, I. Lasiecka, A. Lunardi, R. Schnaubelt, L. Weis, Functional Analytic Methods for Evolution Equations. Editors: M. Iannelli, R. Nagel, S. Piazzera (2004)
- Vol. 1856: K. Back, T.R. Bielecki, C. Hipp, S. Peng, W. Schachermayer, Stochastic Methods in Finance, Bressanone/Brixen, Italy, 2003. Editors: M. Fritelli, W. Runggaldier (2004)
- Vol. 1857: M. Émery, M. Ledoux, M. Yor (Eds.), Séminaire de Probabilités XXXVIII (2005)
- Vol. 1858: A.S. Cherny, H.-J. Engelbert, Singular Stochastic Differential Equations (2005)
- Vol. 1859: E. Letellier, Fourier Transforms of Invariant Functions on Finite Reductive Lie Algebras (2005)
- Vol. 1860: A. Borisjuk, G.B. Ermentrout, A. Friedman, D. Terman, Tutorials in Mathematical Biosciences I. Mathematical Neurosciences (2005)
- Vol. 1861: G. Benettin, J. Henrard, S. Kuksin, Hamiltonian Dynamics – Theory and Applications, Cetraro, Italy, 1999. Editor: A. Giorgilli (2005)
- Vol. 1862: B. Helffer, F. Nier, Hypocoelliptic Estimates and Spectral Theory for Fokker-Planck Operators and Witten Laplacians (2005)
- Vol. 1863: H. Führ, Abstract Harmonic Analysis of Continuous Wavelet Transforms (2005)
- Vol. 1864: K. Efsthathiou, Metamorphoses of Hamiltonian Systems with Symmetries (2005)
- Vol. 1865: D. Applebaum, B.V. R. Bhat, J. Kustermans, J. M. Lindsay, Quantum Independent Increment Processes I. From Classical Probability to Quantum Stochastic Calculus. Editors: M. Schürmann, U. Franz (2005)
- Vol. 1866: O.E. Barndorff-Nielsen, U. Franz, R. Gohm, B. Kümmerer, S. Thorbjørnsen, Quantum Independent Increment Processes II. Structure of Quantum Lévy Processes, Classical Probability, and Physics. Editors: M. Schürmann, U. Franz, (2005)

- Vol. 1867: J. Sneyd (Ed.), *Tutorials in Mathematical Biosciences II. Mathematical Modeling of Calcium Dynamics and Signal Transduction*. (2005)
- Vol. 1868: J. Jorgenson, S. Lang,  $\text{Pos}_n(\mathbb{R})$  and Eisenstein Series. (2005)
- Vol. 1869: A. Dembo, T. Funaki, *Lectures on Probability Theory and Statistics. Ecole d'Été de Probabilités de Saint-Flour XXXIII-2003*. Editor: J. Picard (2005)
- Vol. 1870: V.I. Gurariy, W. Lusky, *Geometry of Mntz Spaces and Related Questions*. (2005)
- Vol. 1871: P. Constantin, G. Gallavotti, A.V. Kazhikhov, Y. Meyer, S. Ukai, *Mathematical Foundation of Turbulent Viscous Flows*, Martina Franca, Italy, 2003. Editors: M. Cannone, T. Miyakawa (2006)
- Vol. 1872: A. Friedman (Ed.), *Tutorials in Mathematical Biosciences III. Cell Cycle, Proliferation, and Cancer* (2006)
- Vol. 1873: R. Mansuy, M. Yor, *Random Times and Enlargements of Filtrations in a Brownian Setting* (2006)
- Vol. 1874: M. Yor, M. Émery (Eds.), *In Memoriam Paul-André Meyer - Séminaire de Probabilités XXXIX* (2006)
- Vol. 1875: J. Pitman, *Combinatorial Stochastic Processes. Ecole d'Été de Probabilités de Saint-Flour XXXII-2002*. Editor: J. Picard (2006)
- Vol. 1876: H. Herrlich, *Axiom of Choice* (2006)
- Vol. 1877: J. Steuding, *Value Distributions of  $L$ -Functions* (2007)
- Vol. 1878: R. Cerf, *The Wulff Crystal in Ising and Percolation Models*, Ecole d'Été de Probabilités de Saint-Flour XXXIV-2004. Editor: Jean Picard (2006)
- Vol. 1879: G. Slade, *The Lace Expansion and its Applications*, Ecole d'Été de Probabilités de Saint-Flour XXXIV-2004. Editor: Jean Picard (2006)
- Vol. 1880: S. Attal, A. Joye, C.-A. Pillet, *Open Quantum Systems I, The Hamiltonian Approach* (2006)
- Vol. 1881: S. Attal, A. Joye, C.-A. Pillet, *Open Quantum Systems II, The Markovian Approach* (2006)
- Vol. 1882: S. Attal, A. Joye, C.-A. Pillet, *Open Quantum Systems III, Recent Developments* (2006)
- Vol. 1883: W. Van Assche, F. Marcellán (Eds.), *Orthogonal Polynomials and Special Functions, Computation and Application* (2006)
- Vol. 1884: N. Hayashi, E.I. Kaikina, P.I. Naumkin, I.A. Shishmarev, *Asymptotics for Dissipative Nonlinear Equations* (2006)
- Vol. 1885: A. Telcs, *The Art of Random Walks* (2006)
- Vol. 1886: S. Takamura, *Splitting Deformations of Deformations of Complex Curves* (2006)
- Vol. 1887: K. Habermann, L. Habermann, *Introduction to Symplectic Dirac Operators* (2006)
- Vol. 1888: J. van der Hoeven, *Transseries and Real Differential Algebra* (2006)
- Vol. 1889: G. Osipenko, *Dynamical Systems, Graphs, and Algorithms* (2006)
- Vol. 1890: M. Bunge, J. Funk, *Singular Coverings of Toposes* (2006)
- Vol. 1891: J.B. Friedlander, D.R. Heath-Brown, H. Iwaniec, J. Kaczorowski, *Analytic Number Theory*, Cetraro, Italy, 2002. Editors: A. Perelli, C. Viola (2006)
- Vol. 1892: A. Baddeley, I. Bárány, R. Schneider, W. Weil, *Stochastic Geometry*, Martina Franca, Italy, 2004. Editor: W. Weil (2007)
- Vol. 1893: H. Hanßmann, *Local and Semi-Local Bifurcations in Hamiltonian Dynamical Systems, Results and Examples* (2007)
- Vol. 1894: C.W. Groetsch, *Stable Approximate Evaluation of Unbounded Operators* (2007)
- Vol. 1895: L. Molnár, *Selected Preserver Problems on Algebraic Structures of Linear Operators and on Function Spaces* (2007)
- Vol. 1896: P. Massart, *Concentration Inequalities and Model Selection*, Ecole d'Été de Probabilités de Saint-Flour XXXIII-2003. Editor: J. Picard (2007)
- Vol. 1897: R. Doney, *Fluctuation Theory for Lévy Processes*, Ecole d'Été de Probabilités de Saint-Flour XXXV-2005. Editor: J. Picard (2007)
- Vol. 1898: H.R. Beyer, *Beyond Partial Differential Equations, On linear and Quasi-Linear Abstract Hyperbolic Evolution Equations* (2007)
- Vol. 1899: *Séminaire de Probabilités XL*. Editors: C. Donati-Martin, M. Émery, A. Rouault, C. Stricker (2007)
- Vol. 1900: E. Bolthausen, A. Bovier (Eds.), *Spin Glasses* (2007)
- Vol. 1901: O. Wittenberg, *Intersections of deux quadriques et pinceaux de courbes de genre 1, Intersections of Two Quadrics and Pencils of Curves of Genus 1* (2007)
- Vol. 1902: A. Isaev, *Lectures on the Automorphism Groups of Kobayashi-Hyperbolic Manifolds* (2007)
- Vol. 1903: G. Kresin, V. Maz'ya, *Sharp Real-Part Theorems* (2007)
- Vol. 1904: P. Giesl, *Construction of Global Lyapunov Functions Using Radial Basis Functions* (2007)
- Vol. 1905: C. Prévôt, M. Röckner, *A Concise Course on Stochastic Partial Differential Equations* (2007)
- Vol. 1906: T. Schuster, *The Method of Approximate Inverse: Theory and Applications* (2007)
- Vol. 1907: M. Rasmussen, *Attractivity and Bifurcation for Nonautonomous Dynamical Systems* (2007)
- Vol. 1908: T.J. Lyons, M. Caruana, T. Lévy, *Differential Equations Driven by Rough Paths*, Ecole d'Été de Probabilités de Saint-Flour XXXIV-2004 (2007)
- Vol. 1909: H. Akiyoshi, M. Sakuma, M. Wada, Y. Yamashita, *Punctured Torus Groups and 2-Bridge Knot Groups (I)* (2007)
- Vol. 1910: V.D. Milman, G. Schechtman (Eds.), *Geometric Aspects of Functional Analysis. Israel Seminar 2004-2005* (2007)
- Vol. 1911: A. Bressan, D. Serre, M. Williams, K. Zumbrun, *Hyperbolic Systems of Balance Laws*, Cetraro, Italy 2003. Editor: P. Marcati (2007)
- Vol. 1912: V. Berinde, *Iterative Approximation of Fixed Points* (2007)
- Vol. 1913: J.E. Marsden, G. Misiolek, J.-P. Ortega, M. Perlmutter, T.S. Ratiu, *Hamiltonian Reduction by Stages* (2007)
- Vol. 1914: G. Kutyniok, *Affine Density in Wavelet Analysis* (2007)
- Vol. 1915: T. Bıykoğlu, J. Leydold, P.F. Stadler, *Laplacian Eigenvectors of Graphs. Perron-Frobenius and Faber-Krahn Type Theorems* (2007)
- Vol. 1916: C. Villani, F. Rezakhanlou, *Entropy Methods for the Boltzmann Equation*. Editors: F. Golse, S. Olla (2008)
- Vol. 1917: I. Veselić, *Existence and Regularity Properties of the Integrated Density of States of Random Schrödinger* (2008)
- Vol. 1918: B. Roberts, R. Schmidt, *Local Newforms for  $\text{GSp}(4)$*  (2007)

- Vol. 1919: R.A. Carmona, I. Ekeland, A. Kohatsu-Higa, J.-M. Lasry, P.-L. Lions, H. Pham, E. Taflin, Paris-Princeton Lectures on Mathematical Finance 2004. Editors: R.A. Carmona, E. Inlar, I. Ekeland, E. Jouini, J.A. Scheinkman, N. Touzi (2007)
- Vol. 1920: S.N. Evans, Probability and Real Trees. Ecole d'Été de Probabilités de Saint-Flour XXXV-2005 (2008)
- Vol. 1921: J.P. Tian, Evolution Algebras and their Applications (2008)
- Vol. 1922: A. Friedman (Ed.), Tutorials in Mathematical BioSciences IV. Evolution and Ecology (2008)
- Vol. 1923: J.P.N. Bishwal, Parameter Estimation in Stochastic Differential Equations (2008)
- Vol. 1924: M. Wilson, Littlewood-Paley Theory and Exponential-Square Integrability (2008)
- Vol. 1925: M. du Sautoy, L. Woodward, Zeta Functions of Groups and Rings (2008)
- Vol. 1926: L. Barreira, V. Claudia, Stability of Nonautonomous Differential Equations (2008)
- Vol. 1927: L. Ambrosio, L. Caffarelli, M.G. Crandall, L.C. Evans, N. Fusco, Calculus of Variations and Non-Linear Partial Differential Equations. Cetraro, Italy 2005. Editors: B. Dacorogna, P. Marcellini (2008)
- Vol. 1928: J. Jonsson, Simplicial Complexes of Graphs (2008)
- Vol. 1929: Y. Mishura, Stochastic Calculus for Fractional Brownian Motion and Related Processes (2008)
- Vol. 1930: J.M. Urbano, The Method of Intrinsic Scaling. A Systematic Approach to Regularity for Degenerate and Singular PDEs (2008)
- Vol. 1931: M. Cowling, E. Frenkel, M. Kashiwara, A. Valette, D.A. Vogan, Jr., N.R. Wallach, Representation Theory and Complex Analysis. Venice, Italy 2004. Editors: E.C. Tarabusi, A. D'Agnolo, M. Picardello (2008)
- Vol. 1932: A.A. Agrachev, A.S. Morse, E.D. Sontag, H.J. Sussmann, V.I. Utkin, Nonlinear and Optimal Control Theory. Cetraro, Italy 2004. Editors: P. Nistri, G. Stefani (2008)
- Vol. 1933: M. Petkovic, Point Estimation of Root Finding Methods (2008)
- Vol. 1934: C. Donati-Martin, M. Émery, A. Rouault, C. Stricker (Eds.), Séminaire de Probabilités XLI (2008)
- Vol. 1935: A. Unterberger, Alternative Pseudodifferential Analysis (2008)
- Vol. 1936: P. Magal, S. Ruan (Eds.), Structured Population Models in Biology and Epidemiology (2008)
- Vol. 1937: G. Capriz, P. Giovine, P.M. Mariano (Eds.), Mathematical Models of Granular Matter (2008)
- Vol. 1938: D. Auroux, F. Catanese, M. Manetti, P. Seidel, B. Siebert, I. Smith, G. Tian, Symplectic 4-Manifolds and Algebraic Surfaces. Cetraro, Italy 2003. Editors: F. Catanese, G. Tian (2008)
- Vol. 1939: D. Boffi, F. Brezzi, L. Demkowicz, R.G. Durán, R.S. Falk, M. Fortin, Mixed Finite Elements, Compatibility Conditions, and Applications. Cetraro, Italy 2006. Editors: D. Boffi, L. Gastaldi (2008)
- Vol. 1940: J. Banasiak, V. Capasso, M.A.J. Chaplain, M. Lachowicz, J. Miękiś, Multiscale Problems in the Life Sciences. From Microscopic to Macroscopic. Będlewo, Poland 2006. Editors: V. Capasso, M. Lachowicz (2008)
- Vol. 1941: S.M.J. Haran, Arithmetical Investigations. Representation Theory, Orthogonal Polynomials, and Quantum Interpolations (2008)
- Vol. 1942: S. Albeverio, F. Flandoli, Y.G. Sinai, SPDE in Hydrodynamic. Recent Progress and Prospects. Cetraro, Italy 2005. Editors: G. Da Prato, M. Rckner (2008)
- Vol. 1943: L.L. Bonilla (Ed.), Inverse Problems and Imaging. Martina Franca, Italy 2002 (2008)
- Vol. 1944: A. Di Bartolo, G. Falcone, P. Plaumann, K. Strambach, Algebraic Groups and Lie Groups with Few Factors (2008)
- Vol. 1945: F. Brauer, P. van den Driessche, J. Wu (Eds.), Mathematical Epidemiology (2008)
- Vol. 1946: G. Allaire, A. Arnold, P. Degond, T.Y. Hou, Quantum Transport. Modelling, Analysis and Asymptotics. Cetraro, Italy 2006. Editors: N.B. Abdallah, G. Frosali (2008)
- Vol. 1947: D. Abramovich, M. Mariño, M. Thaddeus, R. Vakil, Enumerative Invariants in Algebraic Geometry and String Theory. Cetraro, Italy 2005. Editors: K. Behrend, M. Manetti (2008)
- Vol. 1948: F. Cao, J.-L. Lisani, J.-M. Morel, P. Mus, F. Sur, A Theory of Shape Identification (2008)
- Vol. 1949: H.G. Feichtinger, B. Helffer, M.P. Lamoureux, N. Lerner, J. Toft, Pseudo-Differential Operators. Quantization and Signals. Cetraro, Italy 2006. Editors: L. Rodino, M.W. Wong (2008)
- Vol. 1950: M. Bramson, Stability of Queueing Networks, Ecole d'Été de Probabilités de Saint-Flour XXXVI-2006 (2008)
- Vol. 1951: A. Moltó, J. Orihuela, S. Troyanski, M. Valdivia, A Non Linear Transfer Technique for Renorming (2009)
- Vol. 1952: R. Mikhailov, I.B.S. Passi, Lower Central and Dimension Series of Groups (2009)
- Vol. 1953: K. Arwini, C.T.J. Dodson, Information Geometry (2008)
- Vol. 1954: P. Biane, L. Bouten, F. Cipriani, N. Konno, N. Privault, Q. Xu, Quantum Potential Theory. Editors: U. Franz, M. Schuermann (2008)
- Vol. 1955: M. Bernot, V. Caselles, J.-M. Morel, Optimal Transportation Networks (2008)
- Vol. 1956: C.H. Chu, Matrix Convolution Operators on Groups (2008)
- Vol. 1957: A. Guionnet, On Random Matrices: Macroscopic Asymptotics, Ecole d'Été de Probabilités de Saint-Flour XXXVI-2006 (2009)
- Vol. 1958: M.C. Olsson, Compactifying Moduli Spaces for Abelian Varieties (2008)
- Vol. 1959: Y. Nakkajima, A. Shiho, Weight Filtrations on Log Crystalline Cohomologies of Families of Open Smooth Varieties (2008)
- Vol. 1960: J. Lipman, M. Hashimoto, Foundations of Grothendieck Duality for Diagrams of Schemes (2009)
- Vol. 1961: G. Buttazzo, A. Pratelli, S. Solimini, E. Stepanov, Optimal Urban Networks via Mass Transportation (2009)
- Vol. 1962: R. Dalang, D. Khoshnevisan, C. Mueller, D. Nualart, Y. Xiao, A Minicourse on Stochastic Partial Differential Equations (2009)
- Vol. 1963: W. Siegert, Local Lyapunov Exponents (2009)
- Vol. 1964: W. Roth, Operator-valued Measures and Integrals for Cone-valued Functions and Integrals for Cone-valued Functions (2009)
- Vol. 1965: C. Chidume, Geometric Properties of Banach Spaces and Nonlinear Iterations (2009)
- Vol. 1966: D. Deng, Y. Han, Harmonic Analysis on Spaces of Homogeneous Type (2009)
- Vol. 1967: B. Fresse, Modules over Operads and Functors (2009)
- Vol. 1968: R. Weissauer, Endoscopy for GSP(4) and the Cohomology of Siegel Modular Threefolds (2009)

Vol. 1969: B. Roynette, M. Yor, Penalising Brownian Paths (2009)

Vol. 1970: M. Biskup, A. Bovier, F. den Hollander, D. Ioffe, F. Martinelli, K. Netočný, F. Toninelli, Methods of Contemporary Mathematical Statistical Physics. Editor: R. Kotecký (2009)

Vol. 1971: L. Saint-Raymond, Hydrodynamic Limits of the Boltzmann Equation (2009)

Vol. 1972: T. Mochizuki, Donaldson Type Invariants for Algebraic Surfaces (2009)

Vol. 1973: M.A. Berger, L.H. Kauffmann, B. Khesin, H.K. Moffatt, R.L. Ricca, De W. Sumners, Lectures on Topological Fluid Mechanics. Cetraro, Italy 2001. Editor: R.L. Ricca (2009)

Vol. 1974: F. den Hollander, Random Polymers: École d'Été de Probabilités de Saint-Flour XXXVII – 2007 (2009)

Vol. 1975: J.C. Rohde, Cyclic Coverings, Calabi-Yau Manifolds and Complex Multiplication (2009)

Vol. 1976: N. Ginoux, The Dirac Spectrum (2009)

Vol. 1977: M.J. Gursky, E. Lanconelli, A. Malchiodi, G. Tarantello, X.-J. Wang, P.C. Yang, Geometric Analysis and PDEs. Cetraro, Italy 2001. Editors: A. Ambrosetti, S.-Y.A. Chang, A. Malchiodi (2009)

Vol. 1978: M. Qian, J.-S. Xie, S. Zhu, Smooth Ergodic Theory for Endomorphisms (2009)

Vol. 1979: C. Donati-Martin, M. Émery, A. Rouault, C. Stricker (Eds.), Séminaire de Probabilités XLII (2009)

Vol. 1980: P. Graczyk, A. Stos (Eds.), Potential Analysis of Stable Processes and its Extensions (2009)

Vol. 1981: M. Chlouveraki, Blocks and Families for Cyclotomic Hecke Algebras (2009)

Vol. 1982: N. Privault, Stochastic Analysis in Discrete and Continuous Settings. With Normal Martingales (2009)

Vol. 1983: H. Ammari (Ed.), Mathematical Modeling in Biomedical Imaging I. Electrical and Ultrasound Tomographies, Anomaly Detection, and Brain Imaging (2009)

Vol. 1984: V. Caselles, P. Monasse, Geometric Description of Images as Topographic Maps (2010)

Vol. 1985: T. Linß, Layer-Adapted Meshes for Reaction-Convection-Diffusion Problems (2010)

Vol. 1986: J.-P. Antoine, C. Trapani, Partial Inner Product Spaces. Theory and Applications (2009)

Vol. 1987: J.-P. Brasselet, J. Seade, T. Suwa, Vector Fields on Singular Varieties (2010)

Vol. 1988: M. Broué, Introduction to Complex Reflection Groups and Their Braid Groups (2010)

Vol. 1989: I.M. Bomze, V. Demjanov, Nonlinear Optimization. Cetraro, Italy 2007. Editors: G. di Pillo, F. Schoen (2010)

Vol. 1990: S. Bouc, Biset Functors for Finite Groups (2010)

Vol. 1991: F. Gazzola, H.-C. Grunau, G. Sweers, Polyharmonic Boundary Value Problems (2010)

Vol. 1992: A. Parmeggiani, Spectral Theory of Non-Commutative Harmonic Oscillators: An Introduction (2010)

Vol. 1993: P. Dodos, Banach Spaces and Descriptive Set Theory: Selected Topics (2010)

Vol. 1994: A. Baricz, Generalized Bessel Functions of the First Kind (2010)

Vol. 1995: A.Y. Khapalov, Controllability of Partial Differential Equations Governed by Multiplicative Controls (2010)

Vol. 1996: T. Lorenz, Mutational Analysis. A Joint Framework for Cauchy Problems *In* and *Beyond* Vector Spaces (2010)

Vol. 1997: M. Banagl, Intersection Spaces, Spatial Homology Truncation, and String Theory (2010)

Vol. 1998: M. Abate, E. Bedford, M. Brunella, T.-C. Dinh, D. Schleicher, N. Sibony, Holomorphic Dynamical Systems. Cetraro, Italy 2008. Editors: G. Gentili, J. Guenot, G. Patrizio (2010)

Vol. 1999: H. Schoutens, The Use of Ultraproducts in Commutative Algebra (2010)

Vol. 2000: H. Yserentant, Regularity and Approximability of Electronic Wave Functions (2010)

Vol. 2001: T. Duquesne, O. Reichmann, K.-i. Sato, C. Schwab, Lévy Matters I. Editors: O.E. Barndorff-Nielsen, J. Bertoin, J. Jacod, C. Klüppelberg (2010)

Vol. 2002: C. Pötzsche, Geometric Theory of Discrete Nonautonomous Dynamical Systems (2010)

Vol. 2003: A. Cousin, S. Crépey, O. Guéant, D. Hobson, M. Jeanblanc, J.-M. Lasry, J.-P. Laurent, P.-L. Lions, P. Tankov, Paris-Princeton Lectures on Mathematical Finance 2010. Editors: R.A. Carmona, E. Cinlar, I. Ekeland, E. Jouini, J.A. Scheinkman, N. Touzi (2010)

Vol. 2004: K. Diethelm, The Analysis of Fractional Differential Equations (2010)

Vol. 2005: W. Yuan, W. Sickel, D. Yang, Morrey and Campanato Meet Besov, Lizorkin and Triebel (2011)

Vol. 2006: C. Donati-Martin, A. Lejay, W. Rouault (Eds.), Séminaire de Probabilités XLIII (2011)

Vol. 2007: E. Bujalance, F.J. Cirre, J.M. Gamboa, G. Gromadzki, Symmetries of Compact Riemann Surfaces (2010)

Vol. 2008: P.F. Baum, G. Cortiñas, R. Meyer, R. Sánchez-García, M. Schlichting, B. Toën, Topics in Algebraic and Topological K-Theory. Editor: G. Cortiñas (2011)

Vol. 2009: J.-L. Colliot-Thélène, P.S. Dyer, P. Vojta, Arithmetic Geometry. Cetraro, Italy 2007. Editors: P. Corvaja, C. Gasbarri (2011)

Vol. 2010: A. Farina, A. Klar, R.M.M. Mattheij, A. Mikelić, N. Siedow, Mathematical Models in the Manufacturing of Glass. Cetraro, Italy 2008. Editor: A. Fasano (2011)

Vol. 2011: B. Andrews, C. Hopper, The Ricci Flow in Riemannian Geometry (2011)

Vol. 2012: A. Etheridge, Some Mathematical Models from Population Genetics. École d'Été de Probabilités de Saint-Flour XXXIX-2009 (2011)

## Recent Reprints and New Editions

Vol. 1702: J. Ma, J. Yong, Forward-Backward Stochastic Differential Equations and their Applications. 1999 – Corr. 3rd printing (2007)

Vol. 830: J.A. Green, Polynomial Representations of  $GL_n$ , with an Appendix on Schensted Correspondence and Littelmann Paths by K. Erdmann, J.A. Green and M. Schoker 1980 – 2nd corr. and augmented edition (2007)

Vol. 1693: S. Simons, From Hahn-Banach to Monotonicity (Minimax and Monotonicity 1998) – 2nd exp. edition (2008)

Vol. 470: R.E. Bowen, Equilibrium States and the Ergodic Theory of Anosov Diffeomorphisms. With a preface by D. Ruelle. Edited by J.-R. Chazottes. 1975 – 2nd rev. edition (2008)

Vol. 523: S.A. Albeverio, R.J. Høegh-Krohn, S. Maz-zucchi, Mathematical Theory of Feynman Path Integral. 1976 – 2nd corr. and enlarged edition (2008)

Vol. 1764: A. Cannas da Silva, Lectures on Symplectic Geometry 2001 – Corr. 2nd printing (2008)

Edited by J.-M. Morel, F. Takens, B. Teissier, P.K. Maini

**Editorial Policy** (for the publication of monographs)

1. Lecture Notes aim to report new developments in all areas of mathematics and their applications - quickly, informally and at a high level. Mathematical texts analysing new developments in modelling and numerical simulation are welcome.

Monograph manuscripts should be reasonably self-contained and rounded off. Thus they may, and often will, present not only results of the author but also related work by other people. They may be based on specialised lecture courses. Furthermore, the manuscripts should provide sufficient motivation, examples and applications. This clearly distinguishes Lecture Notes from journal articles or technical reports which normally are very concise. Articles intended for a journal but too long to be accepted by most journals, usually do not have this “lecture notes” character. For similar reasons it is unusual for doctoral theses to be accepted for the Lecture Notes series, though habilitation theses may be appropriate.

2. Manuscripts should be submitted either online at [www.editorialmanager.com/lnm](http://www.editorialmanager.com/lnm) to Springer’s mathematics editorial in Heidelberg, or to one of the series editors. In general, manuscripts will be sent out to 2 external referees for evaluation. If a decision cannot yet be reached on the basis of the first 2 reports, further referees may be contacted: The author will be informed of this. A final decision to publish can be made only on the basis of the complete manuscript, however a refereeing process leading to a preliminary decision can be based on a pre-final or incomplete manuscript. The strict minimum amount of material that will be considered should include a detailed outline describing the planned contents of each chapter, a bibliography and several sample chapters.

Authors should be aware that incomplete or insufficiently close to final manuscripts almost always result in longer refereeing times and nevertheless unclear referees’ recommendations, making further refereeing of a final draft necessary.

Authors should also be aware that parallel submission of their manuscript to another publisher while under consideration for LNM will in general lead to immediate rejection.

3. Manuscripts should in general be submitted in English. Final manuscripts should contain at least 100 pages of mathematical text and should always include
  - a table of contents;
  - an informative introduction, with adequate motivation and perhaps some historical remarks: it should be accessible to a reader not intimately familiar with the topic treated;
  - a subject index: as a rule this is genuinely helpful for the reader.

For evaluation purposes, manuscripts may be submitted in print or electronic form (print form is still preferred by most referees), in the latter case preferably as pdf- or zipped ps-files. Lecture Notes volumes are, as a rule, printed digitally from the authors’ files. To ensure best results, authors are asked to use the LaTeX2e style files available from Springer’s web-server at:

<ftp://ftp.springer.de/pub/tex/latex/svmonot1/> (for monographs) and

<ftp://ftp.springer.de/pub/tex/latex/svmultt1/> (for summer schools/tutorials).

Additional technical instructions, if necessary, are available on request from:

[lnm@springer.com](mailto:lnm@springer.com).

4. Careful preparation of the manuscripts will help keep production time short besides ensuring satisfactory appearance of the finished book in print and online. After acceptance of the manuscript authors will be asked to prepare the final LaTeX source files and also the corresponding dvi-, pdf- or zipped ps-file. The LaTeX source files are essential for producing the full-text online version of the book (see <http://www.springerlink.com/openurl.asp?genre=journal&issn=0075-8434> for the existing online volumes of LNM).

The actual production of a Lecture Notes volume takes approximately 12 weeks.

5. Authors receive a total of 50 free copies of their volume, but no royalties. They are entitled to a discount of 33.3% on the price of Springer books purchased for their personal use, if ordering directly from Springer.
6. Commitment to publish is made by letter of intent rather than by signing a formal contract. Springer-Verlag secures the copyright for each volume. Authors are free to reuse material contained in their LNM volumes in later publications: a brief written (or e-mail) request for formal permission is sufficient.

**Addresses:**

Professor J.-M. Morel, CMLA,  
École Normale Supérieure de Cachan,  
61 Avenue du Président Wilson, 94235 Cachan Cedex, France  
E-mail: Jean-Michel.Morel@cmla.ens-cachan.fr

Professor F. Takens, Mathematisch Instituut,  
Rijksuniversiteit Groningen, Postbus 800,  
9700 AV Groningen, The Netherlands  
E-mail: F.Takens@rug.nl

Professor B. Teissier, Institut Mathématique de Jussieu,  
UMR 7586 du CNRS, Équipe “Géométrie et Dynamique”,  
175 rue du Chevaleret,  
75013 Paris, France  
E-mail: teissier@math.jussieu.fr

*For the “Mathematical Biosciences Subseries” of LNM:*

Professor P.K. Maini, Center for Mathematical Biology,  
Mathematical Institute, 24-29 St Giles,  
Oxford OX1 3LP, UK  
E-mail: maini@maths.ox.ac.uk

Springer, Mathematics Editorial, Tiergartenstr. 17,  
69121 Heidelberg, Germany,  
Tel.: +49 (6221) 487-259  
Fax: +49 (6221) 4876-8259  
E-mail: lnm@springer.com