

Bibliography

1. Applebaum, D.: Lévy Processes and Stochastic Calculus. Cambridge University Press, Cambridge, MA (2004)
2. Applebaum, D.: Probability on Compact Lie Groups. Springer, Cham (2014)
3. Applebaum, D., Kunita, H.: Lévy flows on manifolds and Lévy processes on Lie groups. *J. Math. Kyoto Univ.* **33**, 1103–1124 (1993)
4. Arnold, L., Scheutzow, M.: Perfect cocycles through stochastic differential equations. *Prob. Theory Relat. Fields* **101**, 65–88 (1955)
5. Arnold, L.: Random Dynamical Systems. Springer, Berlin (1998)
6. Baxendale, P., Harris, T.E.: Isotropic stochastic flows. *Ann. Prob.* **14**, 1155–79 (1986)
7. Bichteler, K., Gravereau, J.B., Jacod, J.: Malliavin Calculus for Processes with Jumps. Stochastic Monographs, vol. 2. Gordon and Breach, London (1987)
8. Bismut, J.M.: Mécanique Aléatoire. Lecture Notes in Mathematics, vol. 866. Springer, Berlin/Heidelberg/New York (1981)
9. Bismut, J.M.: Martingale, the Malliavin calculus and hypoellipticity under general Hörmander's conditions. *Z. Wahrsch. verw. Gebiete.* **56**, 469–505 (1981)
10. Bismut, J.M.: Calcul des variations stochastique et processus de sauts. *Z. Wahrsch. verw. Gebiete* **63**, 147–235 (1983)
11. Bismut, J.M.: Jump processes and boundary processes. In: Taniguchi Symposium SA, Kyoto 1982, pp. 53–104. Kinokuniya, Tokyo (1984)
12. Blagoveshenskii, Yu.N., Freidlin, M.I.: Certain properties of diffusions processes depending on parameter. *Soviet Math. Dokl.* **2**, 633–636 (1961)
13. Bouleau, N., Denis, L.: Dirichlet Forms Methods for Poisson Point Measures and Lévy Processes. Springer, Cham (2015)
14. Brezis, H.: Functional Analysis, Sobolev Spaces and Partial Differential Equations. Springer, New York (2011)
15. Cameron, R.H.: The first variation of an indefinite Wiener integral. *Proc. Am. Math. Soc.* **2**, 914–924 (1951)
16. Cameron, R.H., Martin, W.T.: Transformations of Wiener integrals under translations. *Ann. Math.* **45**, 386–396 (1944)
17. Carmona, R.A., Nualart, D.: Nonlinear Stochastic Integrators. Equations and Flows. Stochastic Monographs, vol. 6. Gordon and Breach Science Publishers, New York (1990)
18. Chen, Z.-Q., Fukushima, M.: Symmetric Markov Processes, Time Change, and Boundary Theory. Princeton University Press, Princeton (2011)
19. Chen, Z.-Q., Kim, P., Kumagai, T.: Global heat kernel estimates for symmetric jump processes. *Trans. Am. Math. Soc.* **363**, 5021–5055 (2011)

20. Chentzov, N.N.: Limit theorem for some class of functions, ROC. In: All-Union Conference of Theory Probability and Mathematics Statistics, Erevan (1958) (Selected Transl. Math. Stat. Prob. **9**, 11–40 (1970))
21. Dellacherie, C., Meyer, P.A.: Probabilities and Potential B: Theory of Martingales. North Holland, Amsterdam (1982)
22. Doob, J.L.: Stochastic Processes. Wiley, New York (1953)
23. Driver, B.K.: Curved Wiener space analysis. In: Rao, M.M. (ed.) Real and Stochastic Analysis. Birkhauser, Boston (2004)
24. Dynkin, E.B.: Markov Processes, I, II. Springer, Berlin/Heidelberg/New York (1965)
25. Elworthy, K.D.: Stochastic Differential Equations on Manifolds. LMS Lecture Note Series, vol. 70. Cambridge University Press, Cambridge (1982)
26. Elworthy, K.D.: Geometric aspects of diffusions on manifolds. In: Ancona, A., Elworthy, K.D., Émery, M., Kunita, H. (eds.) Stochastic Differential Geometry at Saint-Flour. Probability at Saint-Flour, pp. 113–261. Springer, Berlin (2013)
27. Freidlin, M.L., Wentzell, A.D.: Random Perturbations of Dynamical Systems. Springer, New York (1984)
28. Friedman, A.: Partial Differential Equations of Parabolic Type. Princeton University Press, Princeton (1964)
29. Fujiwara, T.: Stochastic differential equations of jump type on manifolds and Lévy flows. J. Math. Kyoto Univ. **31–1**, 99–119 (1991)
30. Fujiwara, T., Kunita, H.: Stochastic differential equations of jump type and Lévy processes in diffeomorphisms group. J. Math. Kyoto Univ. **25**, 71–106 (1985)
31. Fujiwara, T., Kunita, H.: Canonical SDE's based on semimartingales with spatial parameters. Part II; Inverse flows and backward SDE's. Kyushu J. Math. **53**, 301–331 (1999)
32. Gihman, I.I., Skorohod, A.V.: Stochastic Differential Equations. Springer, Berlin/New York (1972)
33. Girsanov, L.V.: On transforming a class of stochastic processes by absolutely continuous substitution of measures. Theor. Veroyatnost. i Primenen. **5**, 314–330 (1960)
34. Gross, L.: Abstract Wiener spaces. In: Proceedings of Fifth Berkeley Symposium Mathematical Statistics and Probability II., Part 1, pp. 31–42. University of California Press, Berkeley (1967)
35. Gross, L.: Potential theory in Hilbert space. J. Funct. Anal. **1**, 123–181 (1967)
36. Harris, T.E.: Coalescing and noncoalescing stochastic flows in R_1 . Stoch. Proc. Appl. **17**, 187–210 (1984)
37. Hayashi, M., Ishikawa, Y.: Composition with distributions of Wiener-Poisson variables and its asymptotic expansion. Math. Nachr. **285**, 619–658 (2012)
38. Hergason, S.: Differential Geometry, Lie Groups and Symmetric space. Academic, New York (1978)
39. Hunt, G.A.: Semigroups of measures on Lie groups. Trans. Am. Math. Soc. **81**, 264–293 (1956)
40. Ikeda, N., Watanabe, S.: An introduction to Malliavin's calculus. In: Itô, K. (ed.) Stochastic Analysis, pp. 1–52. Kinokuniya, Tokyo (1982)
41. Ikeda, N., Watanabe, S.: Stochastic Differential Equations and Diffusion Processes, 2nd edn. North Holland, Amsterdam (1989)
42. Il'in, A.M., Karashnikov, A.S., Oleinik, O.A.: Linear equation of the second order of the parabolic type (in Russian). Uspehi Math. Nauk **17**(3), 3–146 (1962)
43. Ishikawa, Y.: Density estimate in small time for jump process with singular Lévy measures. Tohoku Math. J. (2) **53**, 183–202 (2001)
44. Ishikawa, Y.: Stochastic Calculus of Variations for Jump Processes. De Gruyter, Berlin (2013)
45. Ishikawa, Y., Kunita, H.: Malliavin calculus on the Wiener-Poisson space and its application to canonical SDE with jumps. Stoch. Process. Appl. **116**, 1743–1769 (2006)
46. Ishikawa, Y., Kunita, H., Tsuchiya, M.: Smooth density and its short time estimate for jump process determined by SDE. SPA **128**, 3181–3219 (2018)

47. Itô, K.: On stochastic processes (Infinitely divisible laws of probability). *Japan. J. Math.* **18**, 261–301 (1942)
48. Itô, K.: Stochastic integral. *Proc. Imp. Acad. Tokyo* **20**, 519–524 (1944)
49. Itô, K.: Brownian motions in a Lie group. *Proc. Jpn. Acad.* **26**, 4–10 (1950)
50. Itô, K.: On stochastic differential equations. *Memoirs Am. Math. Soc.* **4**, 1–51 (1951)
51. Itô, K.: On a formula concerning stochastic differentials. *Nagoya Math. J.* **3**, 55–65 (1951)
52. Itô, K.: Extension of stochastic integrals. In: *Proceedings of International Symposium, SDE Kyoto*, pp. 95–109 (1976)
53. Itô, K., McKean, H.P.: *Diffusion Processes and Their Sample Paths*. Springer, Berlin (1965)
54. Jacob, N.: *Pseudo Differential Operators and Markov Processes*. Imperial College Press, London (2001)
55. Karatzas, I., Shreve, S.E.: *Brownian Motion and Stochastic Calculus*. Springer, New York (1991)
56. Karatzas, I., Shreve, S.E.: *Methods of Mathematical Finance*. Springer, New York (1998)
57. Komatsu, T., Takeuchi, T.: On the smoothness of pdf of solutions to SDE of jump type. *Int. J. Differ. Equ. Appl.* **2**, 141–197 (2001)
58. Komatsu, T., Takeuchi, T.: Simplified probabilistic approach to the Hörmander theorem. *Osaka J. Math.* **38**, 681–691 (2001)
59. Kunita, H.: *Stochastic Flows and Stochastic Differential Equations*. Cambridge University Press, Cambridge (1990)
60. Kunita, H.: Stochastic differential equations based on Lévy processes and stochastic flows of diffeomorphisms. In: Rao, M.M. (ed.) *Real and Stochastic Analysis*. Birkhäuser, Boston (2004)
61. Kunita, H.: Analysis of nondegenerate Wiener-Poisson functionals and its applications to Itô's SDE with jumps. *Sankhya Indian J. Stat.* **73-A(1)**, 1–45 (2011)
62. Kunita, H.: Itô's stochastic calculus: its surprising power for applications. *SPA* **120**, 622–652 (2010)
63. Kunita, H.: Chain rules for Lévy flows and Kolmogorov equations for associated jump-diffusions. In: Zhao, H., Truman, A. (eds.) *New Trends in Stochastic Analysis and Related Topics*. World Scientific, Hackensack (2012)
64. Kunita, H.: Nondegenerate SDE's with jumps and their hypoelliptic properties. *J. Math. Soc. Jpn.* **65**, 993–1035 (2013)
65. Kunita, H., Oh, J.-P.: Asymptotic properties of Lévy flows. *J. Korean Math. Soc.* **27**, 255–280 (1990)
66. Kunita, H., Watanabe, S.: On square integrable martingales. *Nagoya Math. J.* **30**, 209–245 (1967)
67. Kurtz, T.G., Pardoux, E., Protter, P.: Stratonovich stochastic differential equations driven by general semimartingales. *Ann. Inst. Henri Poincaré* **31**, 351–377 (1995)
68. Kusuoka, S.: The non-linear transformation of Gaussian measure on Banach space and its absolute continuity. *J. Fac. Sci. Univ. Tokyo IA* **29(1)**, 567–697 (1982)
69. Kusuoka, S., Stroock, D.W.: Application of Malliavin calculus, Part I. In: Itô, K. (ed.) *Stochastic Analysis. Proceedings Taniguchi International Symposium Katata and Kyoto, 1982*, pp. 271–306. Kinokuniya, Tokyo (1984)
70. Kusuoka, S., Stroock, D.W.: Application of Malliavin calculus, Part II. *J. Fac. Sci. Tokyo Univ. Tokyo Sect. IA Math.* **32**, 1–76 (1985)
71. Kusuoka, S., Stroock, D.W.: Application of Malliavin calculus, Part III. *J. Fac. Sci. Tokyo Univ. Tokyo Sect. IA Math.* **34**, 391–442 (1987)
72. Lamberton, D., Lapeyre, B.: *Introduction to Stochastic Calculus Applied to Finance*. Chapman and Hall, London (1996)
73. Léandre, R.: Flot d'une équation différentielle stochastique avec semimartingale directrice discontinue. In: *Séminaire Probabilités XIX. Lecture Notes in Mathematics*, vol. 1123, Springer, pp. 271–275 (1985)
74. Léandre, R.: Régularités de processus de sauts dégénérés (II). *Ann. Inst. H. Poincaré Probab. Stat.* **24**, 209–236 (1988)

75. Le Jan, Y.: Flots de diffusions dans \mathbb{R}^d . C.R. Acad. Sci. Paris, Ser. I **294**, 697–699 (1982)
76. Li, X.-M.: Strong p -completeness of stochastic differential equations and the existence of smooth flows on noncompact manifolds. PTRF **100**, 485–511 (1994)
77. Malliavin, P.: Stochastic calculus of variation and hypo-elliptic operator. In: Itô, K. (ed.) Proceedings of International Symposium SDE, Kyoto, 1976. Kinokuniya, Tokyo (1978)
78. Malliavin, P.: Géométrie Différentielle Stochastique. Les Presses de l'Université, Montréal (1978)
79. Malliavin, P.: Stochastic Analysis. Springer, Berlin/Heidelberg (1997)
80. Malliavin, P., Thalmaier, A.: Stochastic Calculus of Variations in Mathematical Finance. Springer Finance, Berlin/Heidelberg/New York (2006)
81. Marcus, S.I.: Modelling and approximations of stochastic differential equations driven by semimartingales. Stochastics **4**, 223–245 (1981)
82. Maruyama, G.: Note on Wiener functionals. Kodao Math. Sem. Rep. **2**, 41–44 (1950)
83. Matsumoto, H., Taniguchi, S.: Stochastic Analysis. Cambridge University Press, Cambridge (2016)
84. Meyer, P.A.: Probability and Potentials. Bleisdell, Waltham (1966)
85. Meyer, P.A.: Un cours sur integrals stochastiques. In: Meyer, P.A. (ed.) Seminaire Probability X. Lecture Notes in Mathematics, vol. 511, pp. 246–400. Springer, Berlin (1976)
86. Meyer, P.A.: Transformations de Riesz pour lois gaussiennes. In: Azéma, J., Yor, M. (eds.) Séminaire de Probabilités XVIII. Lecture Notes in Mathematics, vol. 1059, pp. 179–193. Springer, Berlin (1984)
87. Norris, J.: Simplified Malliavin calculus. In: Azéma, J., Yor, M. (eds.) Seminaire de Probabilités, XX. Lecture Notes in Mathematics, vol. 1204, pp. 101–130. Springer, Berlin (1986)
88. Nualart, D.: The Malliavin Calculus and Related Topics, 2nd edn. Springer, Berlin (2006)
89. Nualart, D., Pardoux, E.: Stochastic calculus with anticipating integrands. Probab. Theory Relat. Fields **89**, 407–422 (1991)
90. Oksendal, B.: Stochastic Differential Equations: An Introduction with Applications, 5th edn. Springer, Berlin (1998)
91. Picard, J.: Formules de dualité sur l'espace de Poisson. Ann. Inst. Henri Poincaré, **32**, 509–548 (1996)
92. Picard, J.: On the existence of smooth densities for jump processes. PTRF **105**, 481–511 (1996)
93. Picard, J.: Density in small time at accessible points for jump processes. SPA **67**, 251–279 (1997)
94. Picard, J., Savona, C.: Smoothness of harmonic functions for processes with jumps. SPA **87**, 69–91 (2000)
95. Picard, J., Savona, C.: Smoothness of the law of manifold-valued Markov process with jumps. Bernoulli **19**(5A), 1880–1919 (2013)
96. Protter, P.: Stochastic Integration and Differential Equations. A New Approach. Applied Mathematics, vol. 21. Springer, Berlin/Heidelberg (1992)
97. Revuz, D., Yor, M.: Continuous Martingales and Brownian Motions, 3rd edn. Springer, Berlin (1999)
98. Rogers, L.G., Williams, D.: Diffusions, Markov Processes, and Martingales, I, II, 2nd edn. Wiley, Chichester (1994)
99. Sato, K.: Lévy Processes and Infinitely Divisible Distributions. Cambridge University Press, Cambridge (1999)
100. Shigekawa, I.: Derivatives of Wiener functionals and absolute continuity of the induced measures. J. Math. Kyoto Univ. **208**, 263–289 (1980)
101. Shigekawa, I.: de Rham-Hodge-Kodaira's decomposition on an abstract Wiener space. J. Math. Kyoto Univ. **20**, 263–289 (1980)
102. Shigekawa, I.: Stochastic Analysis. American Mathematical Society, Providence (2004)
103. Skorohod, A.V.: Studies in the Theory of Random Processes. Dover Publication Inc., Mineola/New York (2017) (Original Russian, 1961)

104. Stratonovich, R.L.: A new form of representing stochastic integrals and equations. *Vestnik Moscow Univ. Ser. I. Mat. Mec.* **1**, 3–12 (1964)
105. Stroock, D.W.: The Malliavin calculus, the functional analytic approach. *J. Funct. Anal.* **44**, 212–257 (1981)
106. Stroock, D.W.: Malliavin calculus and its applications to second order parabolic differential operators I, II. *Math. Syst. Theory* **14**, 25–65, 141–171 (1981)
107. Stroock, D.W.: Markov Processes from K. Itô's Perspective. *Annals of Mathematics Studies*, vol. 155. Princeton University Press, Princeton (2003)
108. Stroock, D., Varadhan, S.R.S.: On the support of diffusion processes, with applications to the strong maximum principle. In: *Proceedings of 6th Berkeley Symposium on Probability and Statistics*, pp. 333–359. Berkeley University (1970)
109. Stroock, W., Varadhan, S.R.S.: *Multidimensional Diffusion Processes*. Springer, Berlin/Heidelberg (1979/1998)
110. Sugita, H.: On a characterization of the Sobolev spaces over an abstract Wiener space. *J. Math. Kyoto Univ.* **25**, 717–725 (1985)
111. Sugita, H.: Positive generalized Wiener functionals and potential theory over abstract Wiener spaces. *Osaka J. Math.* **25**, 665–696 (1988)
112. Taniguchi, S.: Malliavin's stochastic calculus of variations for manifold-valued Wiener functionals and its applications. *Z.W.* **65**, 269–290 (1983)
113. Taniguchi, S.: Applications of Malliavin's calculus to time-dependent systems of heat equations. *Osaka J. Math.* **32**, 307–320 (1985)
114. Totoki, H.: A method of construction of measures on function spaces and its applications to stochastic processes. *Memories Fac. Sci. Kyushu Univ. Ser. A. Math.* **15**, 178–190 (1962)
115. Tsuchiya, M.: Lévy measure with generalized polar decomposition and the associated SDE with jumps. *Stochastics Stochastic Rep.* **38**, 95–117 (1992)
116. Watanabe, S.: *Stochastic Differential Equations and Malliavin Calculus*. Tata Institute of Fundamental Research, Bombay (1984)
117. Watanabe, S.: Analysis of Wiener functionals (Malliavin calculus) and its applications to heat kernels. *Ann. Probab.* **15**, 1–39 (1987)
118. Watanabe, S.: Fractional order Sobolev spaces on Wiener space. *Probab. Theory Rel. Fields* **95**, 175–198 (1993)
119. Williams, D.: *Probability with Martingales*. Cambridge University Press, Cambridge (1991)
120. Wong, E., Zakai, M.: On the relation between ordinary and stochastic differential equations and applications to stochastic problems in control theory. In: *Automatic and Remote Control III*. vol. 1, pp. 5–13. Institution of Mechanical Engineers, London (1967)

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