
Peccati, Giovanni and Reitzner, Matthias: *Stochastic Analysis for Poisson Point Processes. Malliavin Calculus, Wiener–Itô Chaos Expansions and Stochastic Geometry*. Springer & Bocconi University Press, Bocconi & Springer Series Vol. 7, 2016. xvi + 346 pp., EUR 89.99, £88.00, US-\$ 139.00 (RRP). ISBN 978-3-319-05233-5.

This is a collection of ten closely coordinated survey papers revolving around the themes of *stochastic geometry* and *stochastic analysis*, in particular Malliavin calculus for jump processes and random measures. Ever since their conception, both fields have gone separate ways and it is for the first time that these fields are brought together in a unified fashion. A catalyst for this development was the 2013 Oberwolfach Mini-Workshop *Stochastic Analysis for Poisson Point Processes: Malliavin Calculus, Wiener-Ito Chaos Expansions and Stochastic Geometry* organized by the editors of this volume.

The chapters and their authors are

1. [MR3585396] Stochastic analysis for Poisson processes (by G. Last, 36 pp).
2. [MR3585397] Combinatorics of Poisson stochastic integrals with random integrands (by N. Priault, 44 pp).
3. [MR3585398] Variational analysis of Poisson processes (by I. Molchanov and S. Zuyev, 21 pp).
4. [MR3585399] Malliavin calculus for stochastic processes and random measures with independent increments (by J.L. Solé and F. Utzet, 41 pp).
5. [MR3585400] Introduction to stochastic geometry (by D. Hug and M. Reitzner, 40 pp).
6. [MR3585401] The Malliavin–Stein method on the Poisson space (by S. Bourguin, Solesne and G. Peccati, 44 pp).
7. [MR3585402] U -statistics in stochastic geometry (by R. Lachièze-Rey and M. Reitzner, 25 pp).
8. [MR3585403] Poisson point process convergence and extreme values in stochastic geometry (by M. Schulte and C. Thäle, 40 pp).
9. [MR3585404] U -statistics on the spherical Poisson space (by S. Bourguin, C. Durastanti, D. Marinucci and G. Peccati, 16 pp).
10. [MR3585405] Determinantal point processes (by L. Decreasefond, I. Flint, N. Privault and G.L. Torrisi, 32 pp).

The chapters are mostly self-contained – with ample references to the current literature – but style and notation are carefully harmonized, so that the text can be used and read in different ways: as always, linear reading from cover to cover is possible, but also the selective reader will find it easy to extract information from the text, and so will anyone searching for a quick reference. There is a joint subject index and frequently the chapters refer to each other. Each

chapter has its own local bibliography; although this underpins the stand-alone character of the surveys, it tends to impede looking up references. Unfortunately, there is no common list of notation.

Roughly speaking, the book has two parts: Chapters 1–4 on stochastic calculus on Poisson spaces and Chapters 5–10 containing material on stochastic geometry with a focus on applications of Malliavin’s calculus to various questions in stochastic geometry. Technically, the Wiener-Itô Chaos decomposition from stochastic calculus and the Stein-Chen method to estimate distances of probability distributions are combined to tackle approximation problems for U -statistics and other limit theorems arising from geometric probability. In each section, the opening chapter gives a bird’s eye view on (stochastic analysis on) Poisson space (Chapter 1) and modern stochastic geometry (Chapter 5), respectively. Chapter 1 also prepares the field for Malliavin calculus, carefully introducing Wiener’s chaos and the usual operators for jump-type Malliavin calculus. Building on this, Chapters 2 and 3 discuss multiple integrals (and their intricate combinatorics) and variational formulae for Poisson space. This is then generalized to *completely* random measures (also known as independent-increment random measures) in Chapter 4. While Chapters 1 and 3 are more survey-style (containing nevertheless some proofs), Chapters 2 and 4 abound with original material.

The second part continues, after the introductory fifth chapter, with an exposition of the Stein- and Stein–Chen method meeting Malliavin’s calculus. The focus is on explicit bounds for distances of probability distributions. In Chapter 7 this is applied to U -statistics (mostly CLT and large deviation estimates) and this theme is continued in Chapter 9 where U -statistics are considered on spherical Poisson random fields. A different application of the Malliavin–Stein–Chen method is in Chapter 8, where it is applied to yield Poisson point process convergence and Weibull limit theorems for the order-statistics of a class of functionals depending on a Poisson or binomial point process. The final chapter makes an excursion into the theory of random matrices; it contains a survey on the construction of diffusions on those configurations whose invariant measure is the law of a determinantal point process. This involves the use of Dirichlet forms.

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MSC2010 Primary: 60-02; Secondary: 60-06; 60D05; 60Fxx; 60G55; 60G57; 60H07; 62G20.