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FAKULTÄT
FÜR MATHEMATIK, INFORMATIK
UND NATURWISSENSCHAFTEN
Fachbereich Mathematik

Kolloquium über Mathematische Statistik und Stochastische Prozesse

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06.02.2018, 16:15 Uhr, Hörsaal 5

Optimal nonparametric inference for discretely observed compound Poisson processes

Abstract:

Compound Poisson processes (CPPs) are the textbook example of pure jump stochastic processes. They approximate arbitrarily well much richer classes of processes such as Lévy processes (LPs). Two parameters characterise them: the drift, and the Lévy jump distribution N driving the frequency at which jumps (randomly) occur and their (random) sizes. Therefore, they provide a simple, yet fundamental, model for random shocks in a system applied in a myriad of problems within natural sciences, engineering and economics.

In most applications, the underlying CPP is not perfectly observed: only discrete observations over a finite-time interval are available. Thus, the process may jump several times between two observations and we are effectively observing a random variable corrupted by a sum of a random number of copies of itself. Consequently, estimating N is a non-linear statistical inverse problem.

In this talk, we will present some of the recent results on optimal nonparametric inference for discretely observed CPPs obtained in [1, 2]: we will construct an estimator resorting to the Fourier domain and applying regularisation techniques, and we will present a general Donsker type-

of theorem (i.e. a functional central limit theorem with the uniform norm) under mild assumptions. This will not only allow us to conclude consistency of the estimator and optimality in an information-theoretic sense, but to address the highly relevant issue of making uncertainty quantification through condence regions and goodness-of-t tests.

This result concerns the so-called low-frequency observation regime in which the observation interval is kept fixed throughout. Indeed, current literature on inference for discretely observed LPs devises different estimators to deal with the low and high-frequency regimes (the latter allows for the observation interval to decrease as the sample size increases). As suggested in [1], estimators built using the Fourier domain should be robust to the observation regime and, tentatively, we will present ongoing work on adaptive density estimation for CPPs observed at arbitrary frequencies.

References

[1] Coca, A. J. (2016). Efficient nonparametric inference for discretely observed compound Poisson processes. Doctoral thesis, doi: 10.17863/CAM.8528
[2] Coca, A. J. (2017). Efficient nonparametric inference for discretely observed compound Poisson processes. Probability Theory and Related Fields, doi: 10.1007/s00440-017-0761-5

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