## PERSONAL INFORMATION

*German and Swiss, born in Vienna, Austria,* October 18, 1978

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| *email* | matthias.kirchner@phnmsbern.ch |
| *phone* | (O) +41 31 310 85 14 |

## SHORT PROFILE

Mathematician and musician; broad teaching, research and performance activities.

## WORK EXPERIENCE

**since 2011 · UNIVERSITY OF TEACHER EDUCATION NMS BERN**

*Head of department (since 2017)*
Member of the executive board. Responsible for department *applied scientific theory and subject teaching and learning* (∼25 lecturers).
Website: www.phnmsbern.ch

*Lecturer for mathematics (since 2013)*
One-year course for first-year students (future primary-school teachers). The course turned out as a series of *best of mathematics*-talks. It seems that I can pass on my enthusiasm. From the student evaluation: '*I was always afraid of mathematics and now it is my favorite subject*'

*Guitar instructor (since 2011)*
Two-year course in guitar for future primary school teachers. Strumming, picking, singing: Great fun!

**2012–2017 · ETH ZURICH**

*Assistant (2012–2017)*
Scientific and teaching support for Prof. Dr. Paul Embrechts: Co-supervision of BA and MA thesis, preparation and correction of exams, sporadic substitute for lectures, talk preparation.

*Teaching assistant (2010–2012)*
Various exercise classes in mathematics at the University of Bern and ETH Zurich.

**2004–2012 · MUSIC SCHOOL, LUCERNE**

*Guitar instructor (2004–2012)*
Pupils from 6 to 18 years.

## MUSICAL ACTIVITIES

**since 2019 · THE COLD COLD HEARTS**

*Swing guitar*
The western-swing band Cold Cold Hearts consists of three fantastic female violin players and singers; harmony singing and triple fiddling is accompanied by guitar and upright bass.

**since 2017 · BLAUI BUEBE**

*Slide guitar*
Together with slam poet Andreas Kessler, *Blaui Buebe* present Swiss German spoken word with underlying old blues tracks. Sometimes funny, sometimes touching.

**since 2015 · SUGARFOOT BROTHERS**

*Banjo and dobro*
The bluegrass band Sugarfoot Brothers performs the repertoire of Bill Monroe and Flatt & Scruggs. It seems that everybody likes the style: from little kids over hipsters to grandmas.

**since 2001 · DUO KIRCHNERMETZGER**

*Classical guitar*
Together with tenor Christoph Metzger, *duo kirchnermetzger* created and performed eight full-length entertaining shows under titles such as *Neapel sehen und sterben* or *¡Olé! - ein spanisches Spektakel*. Their version of Schubert's *Die schöne Müllerin* was especially well-received.

## MATHEMATICAL ACTIVITIES

*Current projects*

Loglinear autoregressive count time series and point processes. Regularity of Hawkes likelihood. Hawkes models on top of SIR graphical models. Palm distribution of Hawkes processes. Quest for a tractable point process model that can produce 'all possible' autocovariance densities. Formula for radius of cyclic pentagon given its side lengths. Singmaster conjecture. Collection and didacticization of unproven mathematical problems that can be understood by school children.

*Talks*

2023: DYOGENE Seminar, INRIA Paris. Conference *Hawkes Processes: Theory and Applications*, University of Warsaw. *INFORMS Applied Probability Conference*, Nancy. 2019: Beijing Institute of Technology. *Séminaire de Recherche Opérations*, Université de Lausanne. Working group *Actuariat et Risques Contemporains*, Sorbonne University, Paris. 2018: *CMStatistics*, Pisa; *Alan Hawkes' 80th Birthday Celebration Workshop*, Swansea. 2017: *RiskDay*, ETH Zurich. 2016: Conference *Hawkes processes in finance*, Cardiff. 2015: European summer school in financial mathematics, *Networks and interactions*, Le Mans, Institut du Risque et de l'Assurance. Listening participant at numerous conferences, e.g., 2015: *The Mathematics and Statistics of Quantitative Risk Management*, Mathematisches Forschungsinstitut Oberwolfach; responsible assistant for conference report. 2013: Workshop *Modeling High-Frequency Trading Activity*, Banff International Research Station, Canada.

*Referee reports*

Referee reports for the following journals: *Annals of Statistics, Biometrika, IEEE Transactions on Information Theory, Journal of Applied Probability, Journal of Financial Econometrics, Journal of Graphical and Computational Statistics, Journal of the Royal Statistical Society, Quantitative Finance, Scandinavian Journal of Statistics, Stochastic Processes and Their Applications, The European Journal of Finance.*

## PUBLICATIONS

*2023*        Fluctuations and precise deviations of cumulative INAR time series

*Stochastic Processes and their Applications (to appear)*

In this paper, we study fluctuations and precise deviations of cumulative INAR time series, both in a non-stationary and in a stationary regime. The theoretical results are based on the recent mod-$\phi$ convergence theory. We apply our findings to the construction of approximate confidence intervals for model parameters and to quantile calculation in a risk management context.
*Full reference:* M. Kirchner and G.L. Torrisi, *SPA*, **164**: 1–32, 2023.

*2023*        Algorithmic alchemy

*Soziale Probleme (in German)*

Algorithmic systems promise to make grading objective and individualize education. Instead of subjective preferences of teachers algorithms seemingly base their decisions about grading and allocating tasks on seemingly objective data. Yet, due to their nontransparent nature new forms of inequality are unwittingly introduced. Datasets and their algorithmic analysis are subject to algorithmic bias, thus not only reproducing but enhancing existing educational inequalities. Two cases for algorithmic bias in education are discussed: intelligent tutoring systems and automated grading. We situate algorithmic systems in their practical context and argue for a strengthening of the teacher profession in light of the portrayed risks.
*Full reference:* T. Röhl and M. Kirchner, *SP*, **34**(2): 273–289, 2023.

*2023*        Critical cluster cascades

*Advances in Applied Probability*

We consider a sequence of Poisson cluster point processes on $\mathbb{R}^d$: At step $n \in \mathbb{N}_0$ of the construction, the cluster centers have intensity $c/(n+1)$ for some $c > 0$, and each cluster consists of the particles of a branching random walk up to generation $n$—generated by a point process with mean 1. We show that this 'critical cluster cascade' converges weakly, and that either the limit point process equals the void process ('extinction'), or it has the same intensity $c$ as the critical cluster cascade ('persistence'). We obtain persistence, if and only if the Palm version of the outgrown critical branching random walk is locally almost surely finite. This result allows us to give numerous examples for persistent critical cluster cascades.
*Full reference:* M. Kirchner, *AAP*, **55**(2): 357–381, 2023.

*2022*      Hawkes model specification for limit order books

*The European Journal of Finance*

We apply the methods and concepts developed in our earlier work to limit-order-book data. In particular, we extend our estimation procedure to multitype marked Hawkes processes. With hardly any a priori assumptions, we derive a fully parametric Hawkes-based model for the event streams of market orders, limit orders, and cancelations.
*Full reference:* M. Kirchner and S. Vetter, *EJF*, **28**(7): 642–662, 2022.

*2018*      A nonparametric estimation procedure for the Hawkes process: comparison with maximum likelihood estimation.

*Journal of Statistical Computation and Simulation*

We present the results of a simulation study, where we compare our estimation procedure with maximum-likelihood estimation. Computation-time wise, the advantages of our method are eminent; statistically, our method competes well.
*Full reference:* M. Kirchner and A. Bercher, *JSCS*, **88**(6):1106–1116, 2018.

*2017*      Hawkes graphs

*Theory of Probability and Its Applications*

We introduce Hawkes graphs, a meaningful yet compact summary of both, multitype Hawkes processes and empirical multitype event stream data. We show how the method from Kirchner (QF, 2017) may be applied to estimate Hawkes graphs from large multitype event streams.
*Full reference:* M. Kirchner and P. Embrechts, *TPA*, **62**(1):163–193, 2017.

*2017*      An estimation procedure for the Hawkes process

*Quantitative Finance*

Based on the discretization results from Kirchner (2016), we introduce a nonparametric estimation procedure for multitype Hawkes processes. We give the asymptotic distribution of the estimates.
*Full reference:* M. Kirchner, *QF*, **17**(4):571–595, 2017.

*2016*      Hawkes and INAR($\infty$) processes

*Stochastic Processes and their Applications*

We show that Hawkes point processes are continuous-time versions of INAR time series and, vice versa, INAR time series are discrete time versions of Hawkes point processes.
*Full reference:* M. Kirchner, *SPA*, **162**(8):2494–2525, 2016.

## EDUCATION

*2012–2017*      ETH Zurich

*PhD in Mathematics*

(not graded) · ETH medal for outstanding doctoral thesis · Walter-Saxer insurance price · Thesis: *Perspectives on Hawkes Processes*
Description: Hawkes processes form a most important modeling class for multitype event streams. Our cumulative thesis presents seven scientific papers that contribute to both, theory and applications.
Advisor: Prof. Dr. Paul Embrechts
Co-advisors: Prof. Dr. Valérie Chavez-Demoulin (Lausanne),
Prof. Dr. Alan Hawkes (Swansea), Prof. Dr. Thomas Mikosch (Copenhagen)

*2009–2012*      ETH Zurich

*Master of Mathematics*

5.8/6 · with distinction ·
Thesis: *Equity-Indexed Annuities with Capital Guarantees*
Description: Using Spitzer's lemma and combinatorical arguments, we derive an analytical pricing formula for High-Watermark-Guarantees and Lookback options in the Black–Scholes–Merton framework.
Advisors: Prof. Dr. Paul Embrechts & Dr. Gerold Studer (NewRe)

*2006–2009*      University of Bern

*Bachelor of Science*

5.5/6 · insigni cum laude ·
Major: Mathematics (5.7/6)
Minor: Computer Science (4.6/6)
Minor: Economics (5.1/6)
Thesis: *Exact and Approximative Distributions of two Statistics on Random Permutations*
Advisor: Prof. Dr. Lutz Duembgen

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| | *2003–2005*   Bern University of the Arts |
| *Concerto Diploma* | 5.6/6  ·  *sehr gut*  · |
| | Main instrument: *Classical guitar* |
| | Courses: Renaissance lute, jazz guitar, voice, composition |
| | Guitar professor: Michel Rutscho |
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| | *1999–2003*   Bern University of the Arts |
| *Teaching Diploma* | 5.7/6  ·  *sehr gut*  · |
| | Teaching diploma for guitar |
| | Guitar professor: Prof. Stephan Schmidt |