

Preface

After having worked in the domain of Gaussian queues for about a decade, we got the idea to look at similar problems, but now in the context of *Lévy-driven* queues. That step felt as going from hell to heaven: it was not that we did not like Gaussian queues, but in that domain almost everything is incredibly hard, whereas in the Lévy framework so many rather detailed results can be obtained and usually with transparent and clean arguments.

Fluctuation theory for Lévy processes is an intensively studied topic, perhaps owing to its direct applications in finance and risk. Over the past, say, 30 years, a lot of progress has been made, archived in great textbooks, such as Bertoin [43], Kyprianou [146], Sato [193], and the more general book on applied probability and queues by Asmussen [19]. The distinguishing feature of this textbook is that we explicitly draw the connection with queueing theory. To some extent, Lévy-based fluctuation theory and queueing theory have developed autonomously. Our book proves that bringing these branches together opens interesting possibilities for both.

This textbook is a reflection of the courses we have been teaching in Wrocław, Poland, and Amsterdam, the Netherlands, respectively. While Lévy processes had already been part of the curriculum for a while, we felt there was a need for a course that more explicitly paid attention to its fluctuation-theoretic elements and the connection to queues. This course should not only cover the central results (such as the Wiener–Hopf-based results for the running maximum and minimum and in particular the resulting explicit formulae for spectrally one-sided cases) but also, e.g. a detailed analysis of various queueing-related quantities (busy period, workload correlation function, etc.), asymptotic results (explicitly distinguishing between light-tailed and heavy-tailed scenarios), queueing networks, and applications in communication networks and finance (with a specific focus on option pricing). This has resulted in this book, with a twofold target audience. In the first place, the book has been written to teach either master’s students or (starting) PhD students. The required background knowledge consists of Markov chains, some (elementary)

queueing theory, martingales, and a bit of stochastic integration theory. In addition, the students should be trained in making their way through some lengthy and technical but usually nice (and in the end rewarding) computations. The second target audience consists of researchers with a background in (applied) probability, but not specifically in the material covered in this book, to quickly learn from—when we entered this area, we would have loved it if there had been such a book, and that was precisely the reason why we decided to write it.

We have written this book more or less remotely, each of us locally testing whether the students liked the way we wrote it. It led to many small and several very substantial changes in the setup. We believe that the current form is the most logical and coherent structure that we could come up with. Having said that, there are quite a number of topics that we could have included, but in the end decided to leave out. Book projects are never finished. . . .

This book would not have been written without the great help of many people. At Springer, Joerg Sixt has always been very supportive of our plans and never put any pressure on us. We also thank Søren Asmussen, Peter Glynn, and Tomasz Rolski, senior researchers in our field, for their encouragement in the early stages of the project.

Krzysztof Dębicki would like to thank the coauthors of his ‘Lévy papers’: Ton Dieker, Abdelghafour Es-Saghouani, Enkelejd Hashorva, Lanpeng Ji, Kamil Kosiński, Tomasz Rolski, and (last but not least) Michel for the joy of the joint work. He is also grateful to his former PhD students Iwona Sierpińska-Tułać and Kamil Tabiś, for valuable comments on ‘Lévy-driven queues’ courses that have been taught at the University of Wrocław. He wants to express his special thanks to Enkelejd Hashorva (University of Lausanne)—warm thanks, Enkelejd, for your exceptional hospitality and wise words on maths and life.

Michel Mandjes would like to thank his ‘Lévy coauthors’ Lars Nørvang Andersen, Jose Blanchet, Onno Boxma, Bernardo D’Auria, Ton Dieker, Abdelghafour Es-Saghouani, Peter Glynn, Jevgenijs Ivanovs, Offer Kella, Kamil Kosiński, Pascal Lieshout, Zbigniew Palmowski, and Tomasz Rolski (besides Krzyś, of course) for the great collaboration over the years. He also would like to extend a special word of thanks to his current PhD students Naser Asghari and Gang Huang, as well as his (former) master’s students Krzysztof Bisewski, Sylwester Błaszczuk, Lukáš Drápal, Viktor Gregor, Mariska Heemskerk, Simaitos Šarūnas, Birgit Sollie, Arjun Sudan, Jan Vlachy, Mathijs van der Vlies, and Dorthe van Waarden, who made numerous suggestions for improving the text. A special word of thanks goes to Nicos Starreveld who proofread the manuscript multiple times. Writing this book benefited tremendously from three quiet periods spent in New York City (!): one, in August 2011, hosted by Jose Blanchet at Columbia University, and two, in December 2013 and March 2014, hosted by Mor Armony and Joshua Reed at New York University—many thanks, Jose, Mor, and Josh!

We conclude with a few personal words. I (Krzyś) would like to thank my beloved family: thanks, Asia and Dobroszek, for all the difference you have made in my life. And I (Michel) would like to use this opportunity to express my deep gratitude to my 'home front': thanks, Miranda, Ester, and Chloe, for giving me the opportunity to do what I like most.

Wrocław, Poland
Amsterdam, The Netherlands
December 15, 2014

Krzysztof Dębicki
Michel Mandjes

Queues and Lévy Fluctuation Theory

Debicki, K.; Mandjes, M.

2015, XI, 255 p. 12 illus., Softcover

ISBN: 978-3-319-20692-9