

Preface

Over the last few decades, Lévy processes have been used extensively in reliability, hydrology, and water resource engineering.

In reliability engineering, they are used to model degradation of devices over time. Certain types of Lévy processes have been found to provide a good model for creep of concrete, fatigue crack growth, corroded steel gates, and chloride ingress into concrete. At the beginning of the work done in reliability, engineers described the uncertainties about the failure times using the survival function; knowing the shape of such a function they can determine and study the properties of the failure rate and, based on that, they can determine the best possible maintenance policies. To estimate the survival function accurately (from a statistical point of view), one has to observe the failure times of many items and these failure random variables are assumed to be independent. In practice, it is not always possible to observe many failures, and even if such failure times are possible to obtain, they are not independent as they all might be affected by an environment. The other approach is to assess the failure of a device based on the characteristics of the process that caused its failure, normally a degradation process. Such an approach is common in assessing the amount of crack, the amount of erosion and creep, and the amount of contamination.

In hydrology and water resource engineering, they are used (among other things) to model the input of water in a reservoir over time. Brownian motion, compound Poisson processes, inverse Gaussian processes, and spectrally positive Lévy processes have been used to describe such input. Knowing the input process and its characteristics enables one to determine and properly improve the cost of running the dam over time.

This monograph consists of three chapters, notations and terminology, and an appendix. In the appendix, we give some basic definitions and results. In [Chap. 1](#) we discuss *Lévy Processes and Their Characteristics*. In [Chap. 2](#), we discuss the applications of Lévy processes in describing *Degradation Processes*. In [Chap. 3](#) we deal with the usage of Lévy processes to describe the input processes and controlling the cost of running reservoirs.

Readers are advised to begin with at least a quick look at the appendix, and the notations and terminology. They serve to review the prerequisite results and definitions. At the end of each chapter as well as in the appendix, relevant references are given. I did not attempt to compile comprehensive bibliographies, but rather give a list of those references that I used to write this book.

Lévy Processes and Their Applications in Reliability and
Storage

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2014, XIV, 116 p., Softcover

ISBN: 978-3-642-40074-2