Chapter 1
Introduction

Data-driven analysis of chemical processes is an area that has developed rapidly since chart recorders started to be replaced by data loggers and digital computers in the 1970s. The rapid development is due in part to the significant advances in computer hardware. An example of the pace of development is that in the last few years while we have been researching and writing this book, the memory available in a portable hard drive for PC data backup has increased by a factor of more than 20 while the physical dimensions and power consumption have stayed the same, and the cost has decreased. Readily available computing power and storage together with high quality and reliable measurements from process instruments have led to increasingly sophisticated and informative methods of analysis to convert data into insights about operations and to provide decision support for process control, operation and maintenance.

At the same time, the education of students and researchers is expanding and becoming more interdisciplinary. Time series analysis, statistical analysis and frequency domain concepts are crossing the boundaries from their traditional homes in electronic, mechanical and aerospace engineering into graduate courses in process operation and control. The sophistication of the methods being applied in data-driven analysis of processes is increasing both in the published academic literature and in commercial tools.

In this monograph, our goal is to present theory and applications for monitoring the performance of continuous processes in the chemical industry using process data. It brings together many results from the past few years in one place and also illustrates the ideas with a range of industrial case studies in which the methods have yielded valuable information. We hope to bring these exciting and useful ideas to the attention of students and researchers who will take them forward into their academic or industrial workplaces.

This chapter begins in Sect. 1.1 by outlining terminology and basic concepts that will underpin the ideas presented later. Section 1.2 gives a brief introduction to control valves and some of their performance issues, and the chapter concludes with a detailed overview of the ideas presented in the book’s chapters.