
Preface to the Fourth Edition

The fourth edition follows the general layout of the third edition but includes some modernization of topics as well as the coverage of additional topics. The preface to the third edition—which follows—still applies, so we concentrate on the differences between the two editions here. As in the third edition, R code for each example is given in the text, even if the code is excruciatingly long. Most of the examples with seemingly endless coding are in the latter chapters. The R package for the text, `astsa`, is still supported and details may be found in Appendix R. The global temperature deviation series have been updated to 2015 and are included in the newest version of the package; the corresponding examples and problems have been updated accordingly.

Chapter 1 of this edition is similar to the previous edition, but we have included the definition of trend stationarity and the concept of prewhitening when using cross-correlation. The New York Stock Exchange data set, which focused on an old financial crisis, was replaced with a more current series of the Dow Jones Industrial Average, which focuses on a newer financial crisis. In Chap. 2, we rewrote some of the regression review, changing the smoothing examples from the mortality data example to the Southern Oscillation Index and finding El Niño. We also expanded on the lagged regression example and carried it on to Chap. 3.

In Chap. 3, we removed normality from definition of ARMA models; while the assumption is not necessary for the definition, it is essential for inference and prediction. We added a section on regression with ARMA errors and the corresponding problems; this section was previously in Chap. 5. Some of the examples have been modified and we added some examples in the seasonal ARMA section. Finally, we included a discussion of lagged regression with autocorrelated errors.

In Chap. 4, we improved and added some examples. The idea of modulated series is discussed using the classic star magnitude data set. We moved some of the filtering section forward for easier access to information when needed. We removed the reliance on `spec.pgram` (from the `stats` package) to `mvspec` (from the `astsa` package) so we can avoid having to spend pages explaining the quirks of `spec.pgram`,

which tended to take over the narrative. The section on wavelets was removed because there are so many accessible texts available. The spectral representation theorems are discussed in a little more detail using examples based on simple harmonic processes.

The general layout of Chap. 5 and of Chap. 7 is the same, although we have revised some of the examples. As previously mentioned, we moved regression with ARMA errors to Chap. 3.

Chapter 6 sees the biggest change in this edition. We have added a section on smoothing splines, and a section on hidden Markov models and switching autoregressions. The Bayesian section is completely rewritten and is on linear Gaussian state space models only. The nonlinear material in the previous edition is removed because it was old, and the newer material is in Douc, Moulines, and Stoffer [53]. Many of the examples have been rewritten to make the chapter more accessible.

The appendices are similar, with some minor changes to Appendix A and Appendix B. We added material to Appendix C, including a discussion of Riemann–Stieltjes and stochastic integration, a proof of the fact that the spectra of autoregressive processes are dense in the space of spectral densities, and a proof of the fact that spectra are approximately the eigenvalues of the covariance matrix of a stationary process.

We tweaked, rewrote, improved, or revised some of the exercises, but the overall ordering and coverage is roughly the same. And, of course, we moved regression with ARMA errors problems to Chap. 3 and removed the Chap. 4 wavelet problems. The exercises for Chap. 6 have been updated accordingly to reflect the new and improved version of the chapter.

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