Some misspecification problems in long-memory time series models
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In the middle of this century, the English hydrologist Harold E. Hurst observed remarkably long cycles on historic records of the Nile river levels. These long non-periodic waves of large amplitude characterized what came to be known as long-memory.

In 1968, Mandelbrot and van Ness proposed a new stochastic model in continuous time, the fractional Brownian motion, that was able to explain the long-memory properties of Nile river data in the framework of stationary processes. A discrete-time model that also exhibits long-memory was later advanced by Granger and Joyeux (1980) and, independently, by Hosking (1981). They introduced the fractionally differenced noise, later generalized to fractional autoregressive and moving average processes, FARMA. Since then, interest in long-memory models has increased, and various studies have investigated the long-run dependence of empirical time series, namely in hydrology, climatology, economics and finance.

The main purpose of this work is to study forecasting problems that can arise in the presence of long-memory. More specifically, we investigate possible sources and consequences of misspecifications when dealing with long-memory processes.

We study in some detail the misinterpretation of a long-memory process as a non-stationary process, leading to an overdifferenced time series and to increased forecasting errors. First, we evaluate the plausibility of this type of misspecification. Second, we characterize the overdifferenced fractional noise and show that the observer is likely to identify it as a low-order ARMA model. Third, we evaluate the increase in forecasting error variance in the cases of both an overdifferenced process with no trend and of an overdifferenced process with erroneously identified trend. Finally, we introduce a spectral regression test for stationarity and derive the periodogram behavior of nonstationary ARIMA processes.