

Irregular Time Series in a Financial Risk Model

Giles Heywood

In financial market data, measurements that are equally spaced in time are the exception rather than the rule. The irregularities result from a number of sources, including order flow, market opening and closing times, timezone differences, weekends and holidays, and calendar irregularities, to name but a few. Depending on the nature of the analysis, these irregularities can represent anything from a minor irritation to a vital part of the analysis.

The **its** package consists of a single S4 class that extends the matrix class, plus a number of methods and functions for handling irregular time series. In this paper we give an overview of the package and a case study of its application to a financial problem concerned with missing data, in part arising from the irregularity of the raw data available. The case study is intended to illustrate the facilities for handling irregular time series, rather than the merits of different statistical methods for handling missing data.

The case study considers the use of the **its** package to solve a realistic practical problem in finance, namely asynchronous holidays. Starting with a panel of daily time-series data for a set of fifty European stocks, we compute the historical covariance matrix, and from that estimate a multi-factor risk model by maximum likelihood. Holidays that are pan-European are excluded entirely from the analysis, but for national holidays, the 'missing' price is estimated using the remaining data plus least squares.