Kálmán filter in financial series

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Abstract

The objective of the present Thesis was to explore a possible financial application of the Kálmán-filter algorithm.

Let us give here a quick summary how Kálmán-filter keeps track of several instruments. At each point in time these instruments are modelled as random variables with multivariate normal distribution. The parameters of this multivariate normal distribution are giving the state of the system (that is, given that the current distribution is known, the future is independent of the past). There are two seperate parts of the algorithm: in the "update" step we modify the state of the system using the measurements (observations) of one or more instruments; in the "predict" step we alter the state based on the time passed without measurements. Each of these measurements can have a measurement error which is assumed to have normal distribution with zero expected value and known variance. Kálmán-filter has two sets of parameters: the variance of the measurement errors, and a covariance matrix of the instruments. Kálmán-filter connects these instruments through this covariance matrix: for example if two instruments have positive covariance, then any measurement update of a single instrument is increasing or decreasing the expected value of both of these instruments at the same time.

We have implemented the algorithm in the Python programming language and chose historical timeseries of stock prices as our data for this analysis.

We have come to the following conclusion: the last observed price is a good prediction for the next price. However, we could increase the precision with the two-dimensional Kálmán-filter if the input errors' matrices were properly chosen.

It can be a future project to make the ongoing algorithm alter input matrices based on the dataset to make refinements.