Measuring the distance of processes

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A milestone in the description of complex processes - for example the ups and downs of share prices - has been reached by mathematicians at the Ruhr-Universität Bochum. Researchers led by Prof. Dr. Holger Dette (stochastics) have developed a new method in spectral analysis, which allows a classical mathematical model assumption, so-called stationarity, to be precisely measured and determined for the first time. The approach also makes it possible to construct statistical tests that are considerably better and more accurate than previous methods. The researchers report on their results in the *Journal of the American Statistical Association.*

Example, share prices: almost all economic models and forecasting tools "suffer" because they are based on a false premise. They assume that the average fluctuation of individual prices and the dependence characteristics between different shares do not change over time. This would make the development of share prices "stationary". This assumption mostly turns out to be wrong in times of crisis, because, for example, under normal market conditions many prices barely affect each other or not at all, whereas in a crash they almost all collapse together. This proves that such a process is generally non-stationary.

Bochum's stochasticians Prof. Dr. Holger Dette, M.Sc. Philip Preuß and Dr. Mathias Vetter, found the key to the whole issue by calculating a distance dimension between the stationary and non-stationary process. "Just as we can determine distances on Earth between two places, we were able to measure the distances or the intervals between the processes" said Prof. Dette. The measure is exactly 0 when the

assumption of stationarity applies to the process. This distance can be estimated from the data and thus provides a reliable tool for the spectral analysis of so-called time series, such as share prices or climate data. "The goal of statistical analyses of time series is always to understand the underlying dependencies in order to then deliver the most accurate predictions possible for the future behaviour of these processes" said Prof. Dette.

"Our research is strongly motivated by the recent financial crises. At that time, nearly all economic models and forecasts for loan losses failed because they do not take appropriate account of extreme dependencies. In the long term, we aim to develop models and methods that predict such events better" said Dette. New methods of asymptotic statistics are crucial to this success and have been researched for years by Bochum's mathematicians, funded by the German Research Foundation in the Collaborative Research Centre SFB 823 "Statistical modelling of nonlinear dynamic processes" (Host university: TU Dortmund University). Here, statisticians from Bochum work together with colleagues from the TU Dortmund University on new statistical methods to statistically verify frequently used model assumptions and develop new and better models where appropriate.

More information: Holger Dette, Philip Preuß, Mathias Vetter. A Measure of Stationarity in Locally Stationary Processes With Applications to Testing. Journal of the American Statistical Association Sep 2011, Vol. 106, No. 495, 1113-1124.
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