Shewhart methodology for modelling financial series

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Abstract

Quality management techniques are widely used in industrial applications for monitoring observable process variation. Among them, the scientific notion of Shewhart principles is vital for understating variations in any type of process or service. This study extensively investigates and demonstrates Shewhart methodology for financial data.

Extremely heavy tails noted in the empirical distribution of stock returns led to the development of new parametric probability distributions for pricing assets and forecasting market risk. Standard asset pricing models have also extended to account the first four (excess) moments in return distributions. These approaches remain complex, but yet they are inadequate for capturing extreme volatility caused by infrequent market events.

It is well known that the security markets are always subjected to a certain amount of variability caused by noise-traders and other frictional price changes. Unforeseen events which are happening in the world may lead to huge market losses. This research shows that Shewhart methodology for partitioning data into common and special cause variations adds value to modelling stock returns.

Applicability of the proposed method is discussed using several scenarios occurring in an industrial process and a financial market. A set of new propositions based on Shewhart methodology is formed for finer description of the statistical properties in stock returns. Research issues which are related to the first four moments, co-moments and autocorrelation in stock returns are identified. New statistical tools such as difference control

charts, odd-even analysis and estimates for co-moments are proposed to investigate the new propositions and research issues. Finally, several risk measures are proposed, and considered with respect to investor's preferences.

The research issues are investigated using partitioned data from S&P 500 stocks and the findings show that in most of the scenarios, contradictory conclusions were made as a result of special cause variations. A modelling approach based on common and special cause variations is therefore expected to lead appropriate asset pricing and portfolio management. New statistical tools proposed in this study can be used to other time series data; a new R-package called QCCTS (Quality Control Charts for Time Series) is developed for this purpose.

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Publications arising from this thesis

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Premarathna, N., Godfrey, A. J. R., and Govindaraju, K. (2017). Control charts for paired differences: $\bar{d}$ and S_d charts. *Quality and Reliability Engineering International*. Early view at http://dx.doi.org/10.1002/qre.2147

Premarathna, N., Godfrey, A. J. R., and Govindaraju, K. (2016a). Assessment of induced autocorrelation in stock returns. *Empirical Economics*. Under review

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