Yuriy Kharin

Robustness in Statistical Forecasting

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Yuriy Kharin
Department of Mathematical Modeling
and Data Analysis
Belarusian State University
Minsk
Belarus

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Preface

Statistical forecasting procedures are used to solve many applied problems in engineering, economics, finance, medicine, environmental studies, etc. For the majority of the developed statistical forecasting procedures, optimality (or asymptotic optimality as observation time increases) is proved w.r.t. the mean square forecast risk under the assumptions of an underlying hypothetical model. In practice, however, the observed data usually deviates from hypothetical models: random observation errors may be non-Gaussian, correlated, or inhomogeneous; the data may be contaminated by outliers, level shifts, or missing values; trend, regression, and autoregression functions do not necessarily belong to the declared parametric families, etc. Unfortunately, the forecasting procedures which have been proved to be optimal under the hypothetical model often become unstable under even small model distortions, resulting in forecast risks or mean square errors which are significantly higher than the theoretical values obtained in the absence of distortion. This necessitates the development of *robust* statistical algorithms, which are designed to retain most of their properties under small deviations from model assumptions.

The available textbooks on the subjects of statistical forecasting and robust statistical methods can be split into two distinct clusters. *The first cluster* includes books on theoretical and applied aspects of statistical forecasting where little or no attention is paid to robustness. The focus of these books is on various hypothetical models, methods, and computer algorithms used in forecasting, as well as their performance in the absence of model distortions.

The second cluster includes books on robust statistics which are dedicated to such diverse subjects as robust statistical parameter estimation, robust hypothesis testing in parametric (e.g., shift-scale) families of probability distributions, regression analysis, discriminant analysis, cluster analysis, time series analysis, etc. However, the topic of robustness in statistical forecasting remains barely touched upon, and little or no information is provided on such important aspects of forecasting as analysis of risk increments due to different types and levels of distortion, estimation of critical distortion levels for the traditional forecasting procedures,