From frontier models in production econometrics to extreme value theory in risk handling

Abdelaati Daouia
Toulouse School of Economics, France

Abstract

This course concentrates around two main themes of interest. The first one deals with nonparametric estimation in boundary regression models, with applications in productivity and efficiency analysis. The second theme focuses on extreme value theory and tail risk handling, with applications in actuarial science, finance and environment.

In the standard model of nonparametric regression the data

$$Y_i = \varphi(X_i) + \varepsilon_i, \quad i = 1, \ldots, n,$$

are observed. In boundary regression models, in contrast to classical theory, the observation errors ($\varepsilon_i$) are not assumed to be centred, but to have a one-sided support ($-\infty, 0]$. This is motivated from abundant applications in economics, education, finance, management, public policy, and other arenas, where rather the support than the mean properties of the noise are known and where the regression function $\varphi$ describes some boundary curve. In most applications, the frontier function $\varphi$ is believed or required to be monotone or concave (convex) monotone. A number of estimation methods of $\varphi$ will be presented in this course, including empirical, smoothed, unrestricted as well as constrained approaches. They also cover data envelopment techniques as well as robust approaches to outliers. The spline smoothing and extreme value methods will be presented in some detail.

The second part of the course is concerned with tail risk estimation from the perspective of extreme values. Three main tools will be considered, namely quantiles, expectiles and extremiles. The class of quantiles lies at the heart of extreme value theory and is one of the basic tools in risk management. The alternative families of expectiles and extremiles define two different least squares analogues of quantiles. They are determined by tail expectations rather than tail probabilities, and have recently been receiving a lot of attention in risk handling accordingly. A comparison between the three competing concepts will be presented from different angles, including the axiomatic theory of risk measures. Their estimation will be explored either making use of traditional order statistics or relying on least asymmetrically weighted squares. The resulting regular estimates will then be extrapolated to the very far tails where very few or no observations are available. Concrete applications to medical insurance data, loss-returns of three large US investment banks, and to earthquake data will be discussed.
References


