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Extreme Value Theory in Risk Management

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Extreme value theory (EVT) is considered to provide the basis for statistical modelling of extreme events. An event is said to be extreme if it is relatively rare, has significant consequences and is statistically unexpected. Various applications of EVT have been implemented in fields like climatology, hydrology, engineering, reinsurance and finance.
In my project I concentrated on its applications in finance as the application of EVT in this field has become more and more popular over recent years.

Financial returns have often been assumed to follow a normal distribution, but lately it is largely agreed that they are usually characterised by fat tails. Although traditional methods for estimating distributions work well around the centre, they often return a poor fit for the extreme tail of the distribution, where not many observations are available. EVT focuses on modelling the tail behaviour of the distribution of negative returns.

The model was fitted to the daily financial returns on the S&P 500 index between 1980 and 2007, using two approaches: the Block Maxima Approach and the Peak over threshold approach. I used the estimated parameters to assess the statistical model and compute tail-related risk measures.

When using the Block Maxima Approach, we divide the data into blocks (e.g. years, semesters, quarters etc.) and fit the Generalized Extreme Value distribution to the dataset consisting of all block maxima. We use the estimated parameters to find the probability that the maximum loss of the next block will exceed all previous losses. We also compute the return level, e.g. the 80 semester return level is the return level that will only be exceeded once in every 80 semesters.

The Peak over threshold approach utilizes more of the available data, by fitting the Generalized Pareto Distribution to all the observations above a certain threshold. Using this approach we can also compute common risk measures like Value at Risk and Expected Shortfall, which are underestimated when computed using the normality assumption.

I appreciate and am thankful for the opportunity that AMSI has offered me as I really enjoyed working on this project and getting a taste of research. Participating in the Big Day In was a great experience and would recommend it to all future scholarship recipients.

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See http://www.ice-em.org.au/students.html#scholarships2007