



Extreme Value Theory and Records

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My AMSI vacation scholarship project focused on a topic in the extreme value theory and records, which is very important in many financial applications such as risk analysis and management.

Extreme value theory is unique as a statistical discipline in that it develops techniques and models for describing the unusual rather than usual. By definition, extreme values are scarce, meaning that estimates are often required for levels of a process that are much greater than have already been observed. This implies an extrapolation from observed levels to unobserved levels, and extreme value theory provides a class of models to enable such extrapolation.

Extreme value is often associated with record. Sometimes we might be interested in the probability of having a record in the next observation rather than the value of the record. And from Renyi Theorem, we know that each time a new observation being a record is independent of the others. Therefore, Poisson approximation can be used to approximate the number of records in n observations, and the accuracy can be further improved by using Refined Poisson approximation.

I spent the majority of my time on reading through lots of books and a few papers, and trying to understand the ideas behind. After that, I calculated the total variance distance for both Poisson approximation and Refined Poisson approximation to verify the rate of convergence.

Having done these, I extended the result from 1 dimension to 2 dimensions, i.e. the records of 2 sequences of random variables. I calculated the probability of any given pair of observations to be a 2 dimensional record and found that they are not independent any more. I also derived the number of 2 dimensional records in 2 sequences of n random variables is approaching $2 \log(n) + 2\gamma - 2 \log 2$ for large value of n , where γ is Euler's constant.

In summary, I would like to say that I found this vacation scholarship program, as well as the Big Day In event, very valuable and rewarding. I not only gained research experience, improved my presentation skills, but also met many interesting and smart people from around the country. I wish to thank AMSI and CSIRO for providing me such a great opportunity.