EXTREMAL TEMPERATURES AND ELECTRICITY LOAD IN SPAIN

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(1) Overview

It is well known that power consumption depends on temperature. Increases in electricity demand are prompted by the use of heating in winters and air/conditioning in summers. On the other hand, due to the fact that the electricity is not storable, shocks in supply or demand cause that price changes in the electricity market are often very large. These spikes have an impact on the amount of market risk that companies face and need to manage.

This paper focuses on how shocks in demand are related to shocks in temperature and how temperature influences the probability on a spike in demand. We estimate the probabilities associated with minimum temperatures in winters and maximum temperatures in summers.

Therefore, one of the goals of this paper is to deal with the behaviour of the tails of temperature series.

(2) Methods

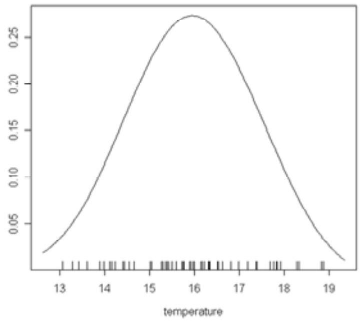
The methodology chosen is the Extreme Value Theory, EVT, since it provides the basis for the statistical modelling of such extremes. This theoretical basis has been used in many fields of modern science and engineering that have to tackle problems derived from events which are rare but have substantial consequences. Recently, it has been progressively applied in other areas such as finance and insurance in order to assess tail related risk. This paper focuses on the use of extreme value theory to extreme quantile estimation in the tail of the distribution of temperature series and on the way it can be related to the level of electricity demand.

(3) Results

We fit the GEV distribution to winter maximum temperature, winter minimum temperature, summer maximum temperature and summer minimum temperature series. For instance, the estimated parameter values obtained for the winter maximum temperature are $(\tilde{\mu}, \tilde{\sigma}, \tilde{\varepsilon}) = [14.455,\ 1.421, -0.308]$. The goodness of fit is quite satisfactory for the fourth series.

Moreover, for each extreme (maximum/minimum) and each season, we determine the 1, 5, 10, 25, 50 and 75th quantiles of temperature anomalies, as shown in the following table.

Quantile	Wintmin
75%	14.97
50%	15.95
25%	16.92
10%	17.76
5%	18.22
1%	18.95



(4) Conclusion

We use the extreme value theory (EVT), specifically the generalized extreme value (GEV) distribution, to the block maxima models for extreme values of temperature in both winter and summer. As well as calculating point estimates for return levels and return periods, we give *l*ikelihood ratio statistic based confidence intervals that reflect the error in the parameter estimates of the GEV distribution. Our results also allow us to confirm a relation between the days in which the temperature has been extremely high (low) and the days with extremely high (low) registered levels of load.