EV

Extreme values

outlier (n): observation whose value lies outside the range considered likely according to some hypothesis (usually, one based on other observations). freaky (adj): strange, unusual, singular. robust (adj): stout, strong and sturdy; insensitive to small departures from the idealised assumptions [Huber, P.J. 1981, *Robust statistics*, Wiley].

Nothing is more contentious than an *outlier*: a measurement much bigger than anything else recorded. One option is to note the value and carry on regardless. No other action may be needed if the analysis is *robust* to the presence of the outlier. The median of annual maxima, *QMED*, is sensitive to the presence but not the magnitude of an unusually large or small annual maximum in the data sample. It is therefore a robust descriptor of the typical size of flood on a catchment.

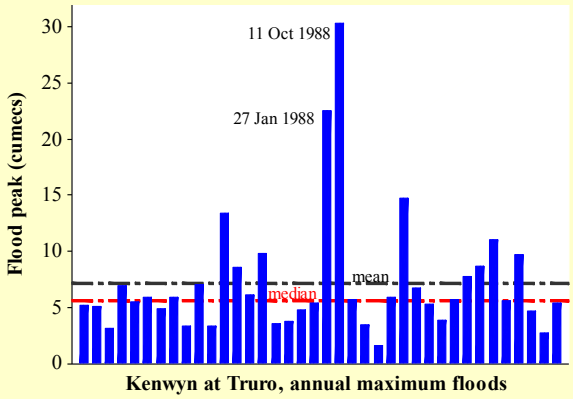
If remarkable scenes have been witnessed, it is tempting to allow this to inform assessment of the flood as freaky. The outlier is interpreted not so much *with* the other data as *against* them. The event is deemed exceptionally rare, the damage made good, and everyone gets on with life believing that they won't see the like of it again.

This may be a correct outcome ... but only after one has researched the genesis of the big flood carefully, and delved into the history of floods in the district *very thoroughly*.

Sensitivities

One way of testing the sensitivity of the frequency curve to any unusual extreme values (*high outliers*) or non-extreme values (*low outliers*) is to temporarily replace the unusual value by a middling value, e.g. *QMED*. There is no justification for allowing a low outlier to influence estimates at the upper end of the frequency distribution. In such cases, a tweaked analysis (eliminating the influence of the low value) can be appropriate. However, there is every reason to allow the analysis to be influenced by a high outlier. Where the value is much larger than others, one should seek collateral information that helps to judge whether the event was indeed freaky, or whether occasional very large values could be a natural feature of the particular catchment.

In the Scottish Highlands, Carrbridge had severe floods in August 1829, June 1914 and July 1923. Bacup in Lancashire met serious floods in August 1849, July 1870 and July 1881. Not least in upland areas such as these, with quick-responding streams, exceptional floods are typically summer events prompted by the sheer intensity of rainfall.

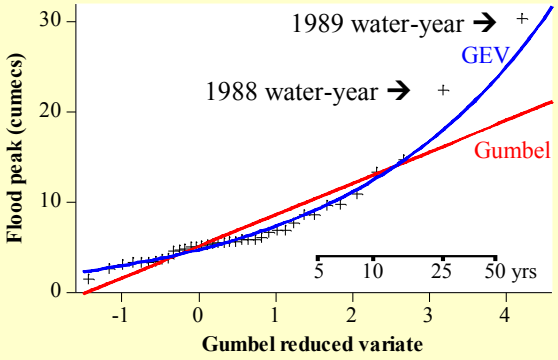


Two floods at three rivers

A theory peddled by the tourist board is that Truro takes its name from a Cornish expression for three rivers. The Allen, Kenwyn and the much smaller Glasteinan conflow in the city. After a relatively benign period, the city suffered a severe flood from the Kenwyn in January 1988. Parliament was told that this had a return period of 340 years: only for a larger flood to occur in October, again from the Kenwyn. The assessment had been based on 19 years of gauged data.

Had the rainfall depths been unprecedented one might put this down to the caprice of climate. But the 1988 floods were triggered by a mix of high groundwater level, saturated catchment and reasonably intense (not remarkable) storm rainfall. Rarity assessment is tough for sites where a combination of factors can be influential, making a historical perspective especially important. One only had to look in the right place in Truro – long the administrative capital of Cornwall – to uncover evidence of earlier severe floods in 1894 and 1955.

Even with double the length of record, the Kenwyn at Truro plot of annual maxima remains a classic:



With tidal & surface-water threats adding to those from the Kenwyn & Allen, the city core remains at risk of severe flooding when circumstances arise that exceed or outflank the now appreciable defences.

Ein mal, kein mal = Just once counts [for] nothing.

German proverb about one-off events or experiments

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