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SMALL CHANGES, BIG IMPACT: THE ROLE OF THRESHOLD SELECTION IN EXTREME RISK ASSESSMENT

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In recent years, extreme events have become an increasing concern across many sectors. Heavy precipitation, disease outbreaks, and huge financial losses have raised the need for better planning for such situations, which requires an understanding of worst-case scenarios. To overcome this issue, analysts use Extreme Value Theory (EVT), which can help evaluate the likelihood of rare and severe events.

One commonly used method in EVT is the Peaks Over Threshold (POT) approach, a critical step in selecting a threshold that separates normal observations from extreme ones. However, an important question arises: If the threshold changes, will the estimated risk also change? The answer is yes, and the impact can be major.

Choosing this threshold is important as it determines the number of exceedances and directly influences the reliability of the results. If the threshold is set too low, the model may include observations that are not truly extreme, leading to underestimated or biased risk estimates. On the other hand, if the threshold is set too high, the number of extreme observations becomes too small, resulting in unstable estimates. Previous studies show that different threshold values can result in significantly different risk estimates, due to the analysis's sensitivity to threshold selection. This affects the reliability of decisions based on EVT (Northrop et al., 2022). As shown in Figure 1, the threshold of 375 mm clearly separates extreme rainfall events from normal observations.

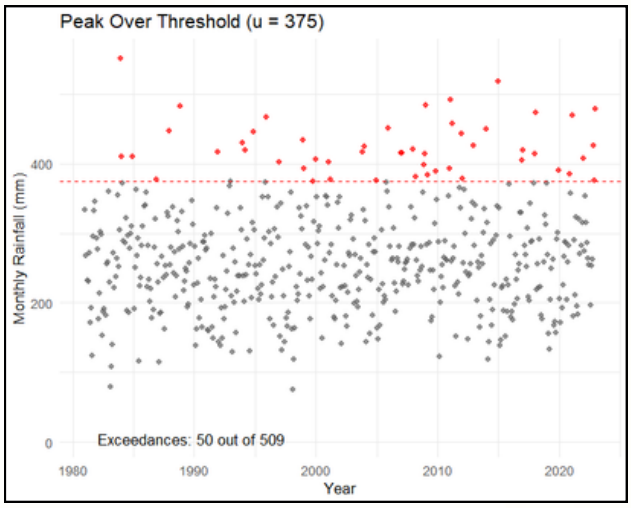

Figure 1: Illustration of the Peaks Over Threshold (POT) approach

EVT is commonly used to estimate extreme rainfall levels, especially during the monsoon season, to support the design of drainage systems, dams, and other flood-control infrastructure. If the threshold is not chosen carefully, flood risk may be underestimated or the design may become unnecessarily costly. In addition, using different threshold values can lead to different model results and levels of uncertainty. For this reason, the choice of threshold should be carefully considered when assessing extreme rainfall risk and planning flood mitigation measures (Alif et al., 2025).

In public health, EVT is used to study extreme spikes in seasonal diseases and their implications on healthcare systems. During periods of high transmission, the number of cases can increase sharply, resulting in sudden spikes in hospital admissions. If the threshold is set too low, normal fluctuations may be treated as critical events, while a threshold that is too high could delay early response and affect hospital preparedness. Extreme value models help estimate the risk of unusually high patient numbers, allowing healthcare providers to anticipate potential congestion and plan resources more effectively (Ranjbar et al., 2022).

In the financial sector, EVT is applied to estimate extreme losses in markets such as the FTSE Bursa Malaysia KLCI. Threshold selection directly influences measures like Value-at-Risk (VaR), which guide capital allocation and risk management. Studies show that threshold uncertainty can significantly affect financial risk estimates, especially during periods of market volatility (Gkillas & Katsiampa, 2021).

Overall, choosing the right threshold is not just a technical issue. It plays an important role in how extreme risks are interpreted and managed. As environmental challenges, public health pressures, and economic uncertainties continue to grow, proper threshold selection is necessary to ensure that risk estimates remain reliable and useful for decision-making.

Beyond statistics, the concept of a threshold reminds us of the importance of limits in everyday life. Knowing where the boundary lies helps us recognise when a situation is becoming excessive and when action is needed. Just as EVT uses thresholds to detect extreme conditions, setting limits in our work, resources, and decisions helps us maintain balance and prevent problems before they escalate.

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