This article considers the potentially misunderstood concept of ‘return period’ primarily in the context of Insurance claims.

We explore how the concept of a return period features in insurance policies and how that concept should be correctly applied and interpreted in general and in the context of assessing claims.

It is important to note that the terms ‘recurrence interval’ and ‘return period’ are considered synonymous and these terms are used inter-changeably in the literature. In this paper, the term ‘return period’ will be used.

Charles Taylor Adjusting (CTA) is often called upon to review significant weather claims affecting property or contract works which involves the determination of a storm category as this can be defined in the policy and have implications for deductible selection and cover.

Some Construction and/or Operational Insurance policies written for significant infrastructure such as mines, ports and railways use the concept of a ‘return period’ to categorise catastrophic events; but this concept and its significance is not always fully appreciated. This lack of appreciation can lead to misunderstandings when dealing with insurance claims and can possibly place the respective parties in an unnecessary adversarial position.
Insurance Policy Intent and Wordings

The basic intent of insurance policies relating to the construction and operation of infrastructure is to provide cover to the unforeseen event (such as accidental damage) and/or rare catastrophic events.

Other day-to-day deleterious and expected events of lesser financial impact are restricted from cover through the application of an appropriate policy deductible or by way of exclusion. However, some policies are much more explicit concerning that part of the risk covered by the policy and this is achieved by specifying a return period for a particular peril not otherwise excluded from cover.

As an example, below is an actual policy wording related to the construction of a large port where the action of the sea is an obvious peril:

*Insurers shall not indemnify the Insured in respect of the expenses incurred for normal action of the sea.*

Normal action of the sea means the state of the sea which manifests itself up to No. 8 on the Beaufort scale, or the state of the tides, current and wave action of the sea, which must be statistically expected to occur once during a 10 year return period, whichever is the more onerous.

Return Period Concept

Return periods are usually quoted in the context of natural events like storms, floods and earthquakes and is a basic means of quantifying and communicating risk. The essential idea is that the severity of natural events is correlated with their frequency of occurrence. For example, on average the occurrence of Category 5 cyclones (the most severe type of cyclone) is relatively rare compared to the occurrence of lesser Category cyclones.

The concept of a return period implies the expected frequency of an event of a given severity or magnitude. If for example, the return period of a Category 5 cyclone is 1 in 100 years for a given area, then people living in that area can expect to experience such a cyclone once every 100 years on average.

The concept of a return period is widely used in Engineering design. Structures and buildings are designed to withstand loads from natural events that are considered rare but nevertheless possible. As an example, a tall building might be designed to withstand loads imparted by earthquakes with a return period of 1 in 1000 years as mandated by relevant design codes.

Past analysis of previous earthquakes in the area allows a relationship between the magnitude of earthquakes and their respective frequencies to be established. This is where some statistical magic comes in (some might say trickery!) because such relationships rely on a great deal of extrapolation. Essentially such an analysis attempts to predict the frequency of extreme events with long return periods and which likely have not occurred during our lifetimes or the generations before.

In the context of Insurance claims, Adjusters use the concept of return period in a subtly different way to Engineers. Adjusters and claim handlers are dealing with a past event (the event giving rise to the claim) and as such, the severity of an event is already known. The unknown quantity of interest then becomes the return period associated with that event.
Implications

A widely held misconception about return periods is that it provides an insight into the timing of an event of interest. This common misconception is best demonstrated by example.

The 1 in 100 year rainfall intensity for Perth in Western Australia is 130mm measured over a continuous 24 hour period. This means that people living in Perth can expect about 130mm of rain to fall within a single day every one hundred years or so.

If such a rare event did in fact occur yesterday, then a resident of Perth might feel relieved to know that such an event is at least another 100 years away and probably beyond his or her lifetime.

That interpretation is quite incorrect, as a similar rainfall event is certainly possible within the following year or within the foreseeable future.

Examining actual rainfall data illustrates why this is so. Figure 1 shows annual rainfall data recorded at Weipa – a small town in far north Queensland. Over the past 100 years, annual rainfall equal to, or in excess of 2500mm is rare. However, between 1994 and 1999, that seemingly rare event occurred during two successive years.

![Figure 1 – Annual rainfall measured at Weipa in Far North Queensland](image)

It can be seen in this example, that annual rainfall varies quite randomly in the short term but in the longer term, a more predictable annual average rainfall emerges that is independent of time. The same concept applies to the calculation of return periods.

When large events of seemingly rare probability occur in quick succession it will often be noted that ‘climate change’ is at play. This is of course a whole other matter for Insurers to grapple with when considering future risks!
Return Period Versus Probability

In terms of expressing and communicating risk, the concept of ‘probability’ is often invoked and in some fields like hydrology, it is being used in preference to the concept of Return Period.

Probability is expressed in mathematical terms and can assume a value of 0, 1 or any value in between. A probability of zero (p=0) indicates that an event has no chance of occurring while a probability of one (p=1) indicates that an event is certain to occur.

An event with a probability of occurrence between zero and one has an uncertain chance of occurrence ranging in broad terms from likely (p>0.5), to unlikely (p<0.5). More refined ways of relating probability to likelihood of occurrence have been devised with one such example given in Table 1 below.

You’ll notice however that the return period in this case referenced years which is not reflected in the probability. In fact it is, but it’s not obvious - the probability that we have just calculated is 1% per year.

A probability of 1% per year simply means that there is a 1 in 100 chance (or 1% chance) of an event with the specified magnitude (or greater) occurring in any given year. This probability is termed the Annual Exceedance Probability (AEP) by the Bureau of Meteorology (BOM) in Australia.

It might be that in the future, Underwriters will begin quoting Annual Exceedance Probabilities in Policies in lieu of Return Period for the purposes of limiting cover.

<table>
<thead>
<tr>
<th>Probability (or likelihood) of the risk occurring</th>
<th>Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5%</td>
<td>Rare</td>
</tr>
<tr>
<td>5% - 25%</td>
<td>Unlikely</td>
</tr>
<tr>
<td>25% - 55%</td>
<td>Possible</td>
</tr>
<tr>
<td>55% - 90%</td>
<td>Likely</td>
</tr>
<tr>
<td>90% - 99%</td>
<td>Almost Certain</td>
</tr>
</tbody>
</table>

The probability of occurrence of an event with a known return period is simply the inverse of the return period. For example, the probability that an event with an associated return period of 1 in 100 years has a probability of occurrence of 1/100 or 0.01 (or 1%). Such an event would be described as ‘rare’ as per Table 1.
Probability of Events over Time

It can be said that, given enough time, even rare events do occur. In that regard, the use of probability theory provides some interesting and counter-intuitive results.

As we mentioned before, at least one occurrence of an event can be expected during a return period stated for that event. It might therefore be inferred that such an event is certain to occur during this period.

That interpretation whilst intuitive, is incorrect. This is because, probabilistic tools are not prophetic and the future remains - as always - unpredictable. This point is demonstrated by example. For a given event with a known return period, it is possible to calculate the probability of the occurrence of that event over ever increasing timeframes. This calculation is shown on Figure 2 for an event with a return period of 1:100 years.

It is immediately obvious that the probability of the event occurring after 100 years (the return period) is around 65% - and not 100% as first thought. In other words, the occurrence of the event is considered ‘likely’ but by no means certain. To be almost certain that the event will occur, a wait period of over 200 years is required.

At the other end of the scale, the probability of occurrence of an event with a 100 year return period is considered possible (40% probability) after just 50 years. This finding explains again why the occurrence of events do not occur in step with their stated return periods (i.e. a 1 in 50 year event cannot be expected to occur every 50 years).

Figure 2 – Probability of experiencing a one in 100 year event over various periods
Insurance implications

By now it will be clear that misinterpreting the concept of a return period is easily done but can be avoided by considering the concepts introduced earlier.

Returning to the previous quoted policy wording referring to sea states, you will recall that Insurers agreed to cover risks involving sea states with a return period of 1 in 10 years or longer. The corresponding annual exceedance probability is 10% and hence such sea states are considered unlikely (refer Table 1).

After a claim for damage following a storm at sea is lodged, it remains to be ascertained if the associated sea states occasioning damage equalled or exceeded those associated with a 1 in 10 year storm.

To make that determination, published return period curves must be sought. It is possible to calculate return periods by hand using a simple spreadsheet and creating such a spreadsheet using available data is easily within the capabilities of an Adjuster with a technical background. However, that approach should only be adopted as a last resort since deriving return periods via this route will prove contentious if it leads to a declinature of a claim.

An example of a published return period curve is reproduced for illustrative purposes in Figure 3 and applies to the peak three second wind gust measured in Darwin and Port Hedland respectively. Note again the projection of best fit curves to very long return periods (1000 years) based on very limited data which is a feature of this type of analysis.

If the involved contractor submitting the claim measured the wind strength on the site during the event leading to damage, then curves like that provided in Figure 3 can be used to estimate the return period of the event. The implication is that the 3 second gust strength is a proxy for sea state. This type of assumption can be common because direct measurement of sea states (like wave height measurements) are often not carried out.

If data from the site of the loss is not available, then data from the nearest weather station has to be relied on. This may add another level of complexity in deciding on the likely return period of the event.

Finally, it should be noted that return period curves are very specific to the measurements that are based on. For example, return period curves for wind strength may be available for the area of interest. It is important to understand the type of averaging applied to arrive at the specified average wind strength. Averages for wind strength are usually calculated over 10 minute intervals and only wind strength averages derived in that way apply to that curve.

Figure 3 – Typical return period curves provided in the literature
Conclusion

This article has shown that it is easy to read more into the concept of return period than you should. The return period is another way of expressing probability – and more specifically annual exceedance probability (AEP).

The calculation of a return period is easily achieved if basic data is available but it is preferable to use published return periods when working in a claims environment to avoid disputes.

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We ensure outcomes are concisely reported to Insurers to match their requirements in documenting the circumstances of the loss in a clear and logical manner, allowing them to reach a conclusion in respect to policy response.

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