So far we have seen how to calculate exposures when we have sufficient time and computational capability. However, often that is not the case. The typical problems that we may face include not having access to a Monte Carlo simulation engine, slow pricers,\(^1\) lack of a collateral algorithm in the Monte Carlo engine, etc.

When doing simplifications and approximations, the science of quantitative analysis becomes quite an art. This is because we have to make some intuition-based assumptions to come up with a result that is reasonable. Sometimes we may not have the tools needed, and we have to be somewhat blunt with these assumptions. Needless to say, this needs to be treated with care, as it is very easy to make incorrect assumptions and simplifications. Time and practice provides the experience required to make these assumptions in a proper and informed way.

**Quantiles of normal distribution:** In the art of proxing, we often need to derive exposure profiles assuming normality in probability distributions. So it will be useful to see what are the quantiles of a number of typical exposure metrics in those normal conditions.

If \( \sigma \) is the standard deviation of the normal distribution, the following table shows the quantiles for EPE, ENE and typical PFE and CESF values:

<table>
<thead>
<tr>
<th>Confidence level</th>
<th>PFE ( \times \sigma )</th>
<th>CESF ( \times \sigma )</th>
</tr>
</thead>
<tbody>
<tr>
<td>90%</td>
<td>1.28 ( \times \sigma )</td>
<td>1.72 ( \times \sigma )</td>
</tr>
<tr>
<td>95%</td>
<td>1.64 ( \times \sigma )</td>
<td>2.03 ( \times \sigma )</td>
</tr>
<tr>
<td>97.5%</td>
<td>1.96 ( \times \sigma )</td>
<td>2.30 ( \times \sigma )</td>
</tr>
<tr>
<td>99%</td>
<td>2.33 ( \times \sigma )</td>
<td>2.63 ( \times \sigma )</td>
</tr>
</tbody>
</table>

### 6.1 Mark-to-market + add-on

The most simplistic methodology to calculate exposure was in fact used by the Basel Committee in its Basel I accord in the context of regulatory capital. According to this, the exposure of a trade is given by its present value, its “Mark-to-Market” (MtM), plus an add-on number that is tabulated. Figure 6.1 shows an example of an add-on table proposed by the Basel Committee.
These tables give the exposure add-on for single trades so that the exposure of a trade is given by:

$$\text{Exposure} = \text{MtM} + \text{Addon}$$ \hspace{1cm} (6.1)

where MtM is the Mark-to-Market, the price under the typical risk-neutral assumptions, of the trade; and the Addon is calculated by multiplying the trade notional ($N$) by its percentage value ($x\%$) in the add-on table,

$$\text{Addon} = N \cdot x\%$$ \hspace{1cm} (6.2)

When we have a netting set, netting can be partly accounted for by having a dispersion coefficient $\gamma$ so that the exposure of the netting set is given by

$$\text{Exposure}_{NS} = \sum_{\text{trades}} \text{MtM}_{\text{trade}} + \gamma \sum_{\text{trades}} \text{Addon}_{\text{trade}}$$ \hspace{1cm} (6.3)

The tables that give the add-ons can be as granular as we want. We could have, for example, one add-on number for all interest rates swaps, or one per currency, or include more granularity based on tenors, long/short, etc.; then we could have another set of tables for options, swaptions, forwards, etc. The level of granularity is endless. The choice should be based on what the institution can handle with its available resources. Obviously, in most cases, the more granular it is, the more accurate the risk is going to be.

Figure 6.2 shows an example of a netting set calculation using this method in which we can see how $\gamma$ can be calculated. We start with the current value of the trades (MtM). The add-on of each trade is given by its notional multiplied by the tabulated coefficient. The dispersion coefficient can be calculated in two ways. A popular methodology is using the Net to Gross Ratio (NGR). NGR tries to measure the dispersion effect by dividing the netting set MtM by the sum of the current exposure of each trade.

This method was proposed by Basel and may provide an adequate approximation for large portfolios, but it is obviously very crude and can lead to very surprising results. For example, for two different trades that happen to have equal but opposite signs MtM will have zero exposure, as shown in Figure 6.3.

An alternative method would be to come with a more or less conservative average of this coefficient with a portfolio model, either analytically or by building a Monte Carlo simulation of an average portfolio.

**Building the add-on tables**: The add-on tables can be calculated with spreadsheet based models, either using simple Monte Carlo simulations or with any of the other appropriate methodologies, like the ones suggested later in this chapter. The add-on number should be based on the peak of the exposure profile given by these models for risk management, or on an average value for pricing. They should be recalibrated periodically. Those recalibrations should be done quarterly at least, with ad hoc recalibrations during periods of market stress.