

20 Volatility

In a sense, volatility is “everything”. If there was no volatility, all of us would be out of work, and all financial transactions could be handled by your bank’s Automated Teller Machine. In this light, it is not surprising that essentially all matters in trading and risk management revolve around measuring, valuing, and managing volatility (risk).

Caveat: Subsets and elements of this Chapter appear in some of other TG2 Books, such as [1] and [2]. Although there is some repetition, there is additional material here, and also additional perspectives in the context of options trading. Please go through it, even if you have seen some of the material previously.

In any case, the authors firmly believe that preparation for professional trading demands repetition of the material until it is “second nature”.

As stated throughout this Series, the word “arbitrage” is the most abused word in our business. The word “volatility” is possibly the second most abused word. Part of the difficulty with “volatility” is that it is used in several distinct but related contexts. This Chapter discusses various flavours of “volatility”. In addition, this Chapter provides introductory discussion on the connection between these “flavours”, the real world, and important definitions required throughout the Series. Importantly, the “traded volatility” matters are then treated in deeper detail in the PaR and Position Keeping Chapters below.

The three primary flavours of “volatility” arise from:

- **Model or Implied Volatility:** Parameters extracted from or used in (stochastic) valuation models (e.g. options) based on quoted prices. This is by far the most prevalent method for obtaining vols for options pricing/position keeping.
- **Historical Volatility:** The statistical measures of variance of stochastic histories (and distributions). This flavour of volatility is referred to as “statistical volatility”, “empirical volatility”, or (most often) “historical volatility”.
- **Trading/P&L Volatility:** These vols are “descriptors of trading dynamics”, and includes factors such the costs/ramifications of the actual rebalance strategy, and the prices at which the rebalances were/can be executed.

Although these three “families of volatility” are presented as distinct ideas, in reality there will be overlaps/interactions, which are discussed to some extent in this Book, and especially in [8.a] and [8.c].

The term “realised volatility” is also used, but care is required as this expression means something slightly different when discussing implied vols vs. traded vols.

In addition to “basic” volatility, a comprehensive treatment of volatility requires descriptions of a family of statistical measures, which for immediate purposes means the inclusion of correlation, covariance, and in some cases “higher moments”.

Within each of these families of volatility, one may also express sub-flavours of volatility. Most importantly, there will be the distinction between Price/Yield and Absolute/Relative volatilities, and their relationships and implications. These types of issues tend arise most often with IR options; so detailed derivation/application is deferred to [8.b].

Separate from the actual definition of the different flavours of volatility are “real world” usage issues. This requires reflection on “practical” limitations of the trading floor, and “market convention” practices, primarily “cheap & cheerful” solutions to otherwise difficult technical questions, such as how a long price history should be used to obtain historical vols, correlations, etc.

There are some topics which require an “honourable mention” here, but really belong elsewhere. Each of the flavours of volatility is considered in much greater detail (and as applicable to the trading of the specific instruments), in [8.c], and the relevant TG2 “trading” books.

Importantly, measures of volatility are usually presented in the context of price or returns histories (or their distributions). As such, much of the discussions on volatility in this Chapter will relate to the calculation and usage of volatilities that are required as direct inputs to pricing and risk management valuations (e.g. historical and implied vols).

However, it will also be shown that the description of trading volatility, P&L volatility (both for management and for advanced analysis such as Profit at Risk (PaR)), and other “business mandate” measures are crucial in the real world as well. These methods can also be used explicitly for pricing, but more importantly these methods are useful for developing P&L optimal position keeping strategies/operating mandates, where “volatility” transcends the narrower “pricing input” usage.

This Chapter also touches on certain advanced volatility concepts, with details to follow in the TG2 “trading” books.

<p><u>Aside</u>: As must be clear even at this stage, it is best to be in the habit of separating volatility concepts that apply at the “micro level” (e.g. option pricing inputs), from volatility considerations that apply at “big picture” levels (e.g. volatility in the context of rebalance strategies, and optimal P&L performance).</p>
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Caveat: One point that cannot be stressed too often or too strongly is that of data quality. It is so very easy to “discover the arb of a lifetime” only to lose a “ton of money” and then learn that the entire trade idea was based on bad data. Be sure to take great care on data quality, or at least on the interpretation of the results.