VRV: Volmex Realized Volatility Indices

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This paper introduces the realized volatility methodology that Volmex employs to calculate Volmex Realized Volatility Indices (VRV), and specifies in detail how to calculate these indices.

1 Introduction

Market participants are always interested in understanding how wide the price swings might be, especially when they want to enter into a new position or exit from an existing one. The magnitude of these price movements is determined by the standard deviation of the current return distribution. Therefore, volatility (quoted as percent), as the annualized standard deviation of returns, is an important indicator of the current state of the price moves.

However, measuring volatility is a challenging task since it is a latent variable. Some tasks like choosing a mathematical proxy and discretizing this proxy, make the volatility measurement complicated and require further investigation.

It is common in practice to use the sum of the frequently sampled squared returns, though this suffers from market microstructure noise.

This paper serves the purpose of offering market participants a reliable and consistent proxy measure for the crypto asset return volatility which minimizes the effect of market microstructure noise, and uses realized volatility (RV) as the measure. The following sections introduce the methodology and analyze how to implement the methodology.

2 Volmex Realized Volatility Index

VRV measures the historical realized volatility of a crypto asset by using 1-minute returns rolling every minute (i.e non-overlapping) with an exponential decay factor of λ for variance updating.
Before discussing the details, first we define returns. We use log difference of spot price levels since it can transform the probability distribution of original

variables into more normal-looking distributions:

$$r_{S,t} = \ln S_t - \ln S_{t-\Delta t} \tag{1}$$

where S_t is the price level of a crypto asset at time t, and Δt is the 1-minute time step which is the time difference between two observations.

$$\mathrm{RVar}_t = \lambda \times \mathrm{RVar}_{t-1} + (1-\lambda) \times r_{S,t}^2 \tag{2}$$

$$\mathrm{VRV}_t = 100 \times \sqrt{A \times \mathrm{RVar}_t} \tag{3}$$

where RVar_t is the exponentially-weighted realized variance price of a crypto asset at time t expressed as minutes, and $A = 365 \times 24 \times 60$ is the annualization multiplier.

The value of λ is set based on the span of the exponential-weighting. The relation between span and λ is the following

$$\lambda \equiv 1 - \frac{2}{1 + \mathrm{SPAN}} \tag{4}$$

where SPAN is expressed in minutes. So if the span is 1-day, $\mathrm{SPAN} = 1 \times 24 \times 60 = 1440$, and $\lambda = 1 - 2/(1 + 1440) \approx 0.998612$ which implies that the weight of squared log-return observation gets halved in about third of a day:

$$\lambda^H = \frac{1}{2} \tag{5}$$

$$\Rightarrow H = -\frac{\ln 2}{\ln \lambda} = \approx 499.07 \tag{6}$$

where each step of H is a minute and 499.07 minutes $\approx$ 8.32 hours $\approx$ 0.35 day.

Lastly, the naming of the indices are based on the span and token symbols, as the following: `xVRVyD` means the Volmex Realized Volatility of token x with span of y-day. ETH and BTC indices use only first letters whereas the rest of the tokens keep all the letters. Some examples are: `EVRV3D` (ETH VRV with 3-day span), `BVRV2W` (BTC VRV with 2-week span) and `DOGE1M` (DOGE VRV with 1-month span).

3 Conclusion

This paper introduces a methodology to calculate Volmex Realized Volatility Indices using non-overlapping 1-minute log-returns at various spans. Its main aim is to serve as an indicator and gives a better sense of current volatility state of the market than traditional textbook style realized volatility estimates.