

Calculating Historical Volatility (HV) with Example

by Frank Cabrera (lajiri@gmail.com)

The formula for computing the Historical Volatility (HV), is:

Figure 1

$$s = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - m)^2}$$

where s = standard deviation

n = number of continuous returns (not number of days)

x_i = continuous returns

m = mean price change

Example: 5 day price table

Assume a security has the following closing prices for five days:

Day 1	Day 2	Day 3	Day 4	Day 5
100	100.8	100.3	100.2	100.03

Step 1: Compute the continuous return for each day

Using the following formula:

$$x_i = \ln\left(\frac{day_i}{day_{i-1}}\right)$$

The continuous returns are as follows:

Day 1	Day 2	Day 3	Day 4	Day 5
	.007968	-.004973	-.000998	-.001698

Step 2: Compute the average of the continuous returns

Using the following formula and the values obtained from Step 1:

$$m = \frac{1}{n} \sum_{i=1}^n x_i$$

Average continuous returns is:

$$m = \frac{.007968 - .004973 - .000998 - .001698}{4}$$
$$m = .00007475$$

Step 3: Compute the standard deviation

Using the HV formula (Figure 1), the standard deviation is:

$$s = \sqrt{\frac{(.007968 - .00007475)^2 + \dots + (.001698 - .00007475)^2}{3}}$$
$$s \approx .0046707 \approx HV$$

Optional: Scale as necessary

To scale the historical volatility, multiply the HV (obtained in step 3) by the square root of the scale factor.

Using the values from the example, and assuming there 248 trading days in a year, the annualized HV is:

$$\text{Annualized HV} = .0046707 \times \sqrt{248} \approx .07355$$

Assuming 52 weeks in a year, the weekly HV is:

$$\text{Weekly HV} = .0046707 \times \sqrt{52} \approx .03368$$