

Historical Open-High-Low-Close Volatility: Garman Klass

created by **Thijs van den Berg**

$$\sigma = \sqrt{\frac{Z}{n} \sum \left[\frac{1}{2} \left(\ln \frac{H_i}{L_i} \right)^2 - (2 \ln 2 - 1) \left(\ln \frac{C_i}{O_i} \right)^2 \right]}$$

The Garman and Klass estimator for estimating historical volatility assumes Brownian motion with zero drift and no opening jumps (i.e. the opening = close of the previous period). This estimator is 7.4 times more efficient than the close-to-close estimator.

Symbol list:

σ	Volatility
Z	Number of closing prices in a year
n	Number of historical prices used for the volatility estimate
O_i	The opening price
H_i	The high
L_i	The low
C_i	The close