



# APPENDIX

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## HISTORICAL VOLATILITY CALCULATIONS

The historical volatility is defined as the standard deviation of the logarithmic price changes measured at regular intervals of time. Since settlement prices are usually considered the most reliable, the most common method of computing volatility involves using settlement-to-settlement price changes. We defined each price change,  $x_i$ , as:

$$x_i = \ln(P_i / P_{i-1})$$

where  $P_i$  is the price of the underlying contract at the end of the  $i^{th}$  time interval.

$P_i/P_{i-1}$  is sometimes referred to as the *price relative*.

Week	Underlying Price	$\ln(P_i/P_{i-1})$	Mean	Deviation from Mean	Deviation Squared
0	101.35		↑ +.001167 ↓		
1	102.26	+ .008939		.007771	.000060
2	99.07	- .031692		-.032859	.001080
3	100.39	+ .013236		.012069	.000146
4	100.76	+ .003679		.002512	.000006
5	103.59	+ .027699		.026532	.000704
6	99.26	- .042698		-.043865	.001924
7	98.28	- .009922		-.011089	.000123
8	99.98	+ .017150		.015982	.000255
9	103.78	+ .037303		.036136	.001306
10	102.54	<u>- .012020</u>		-.013188	<u>.000174</u>
		+ .011674		.005778	

We first calculate the standard deviation of the logarithmic price changes:

$$\begin{aligned}\text{standard deviation} &= \sqrt{(.005778 / 9)} \\ &= \sqrt{.000642} \\ &= .025338\end{aligned}$$

We then calculate the annual volatility by multiplying the standard deviation by the square root of the time interval between price changes. Since we looked at price changes every week, the time interval is  $365/7$ :

$$\begin{aligned}\text{annualized volatility} &= .025338 \times \sqrt{(365 / 7)} \\ &= .025338 \times \sqrt{52.14} \\ &= .025338 \times 7.22 \\ &= .1829 \text{ (18.29\%)}\end{aligned}$$

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