

✓	2. Diversification
✓	3. Portfolio Mean
✓	4. Portfolio Variance
✓	5. Reducing Risk
✓	6. Quiz: Variance of a 3-Asset Portfolio
✓	7. The Covariance Matrix and Quadr...
✓	8. Calculate a Covariance Matrix
✓	9. Quiz: np.cov
✓	10. The Efficient Frontier
✓	11. Capital Market Line
✓	12. The Sharpe Ratio
	13. Other Risk Measures
	14. The Capital Assets Pricing Model
	15. Quiz: Portfolio Return with a 3-As...
	16. Summary

---

Knowledge
Search project Q&A

---

Student Hub
Chat with peers and mentors



## The Sharpe Ratio

The Sharpe ratio is the **ratio of reward to volatility**. It's a popular way to look at an asset relative to its risk.

$$\text{Sharpe Ratio} = \frac{r_{\text{risky portfolio}} - r_{\text{risk free}}}{\sigma_{\text{excess return}}}$$

The numerator of the Sharpe ratio is called the *excess return*, *differential return* or *risk premium*. It's called "excess return" because this is the return in excess of the risk-free rate, called the "risk premium", because this represents the premium that investors demand for taking on risk.

The denominator is the volatility of the excess return.

How do you calculate this? The *risk premium* (which we'll denote with  $D_t$ ) equals the return minus risk-free rate over a period of time:

$$D_t = r_{\text{portfolio}, t} - r_{\text{risk free}, t}$$

Then, calculate the mean and standard deviation of  $D_t$  over the historical period:

$$D_{\text{average}} = \frac{1}{T} \sum_{t=1}^T D_t \quad \sigma_D = \sqrt{\frac{\sum_{t=1}^T (D_t - D_{\text{average}})^2}{T-1}}$$

$$\text{Sharpe Ratio} = \frac{D_{\text{average}}}{\sigma_D}$$

As we saw previously, the Sharpe Ratio is the slope of the *Capital Market Line*.

The Sharpe Ratio allows us to compare stocks of different returns, because the Sharpe Ratio adjusts for the level of risk.

[Note that if you do not see some fractions displaying as expected, please try to refresh the page or use a different browser]

## Annualized Sharpe Ratio

Please keep in mind that the Sharpe Ratio depends on the time period over which it is calculated. It's normally annualized. You annualize it in the same way you annualize volatility. As a refresher on annualization, please refer to the video on annualization within this course. For example,

$$\text{Sharpe Ratio}_{\text{year}} = \sqrt{252} \text{ Sharpe Ratio}_{\text{day}}$$

Let's see where the square root of 252 trading days comes from by annualizing the numerator, and then annualizing the standard deviation in the denominator. Together, they form the annualized Sharpe Ratio.

To annualize daily risk premium ( $r_p - r_f$ ), we add the daily return 252 times, or multiply by 252.  $D_{\text{year}} = 252 \times D_{\text{day}}$

To annualize the daily standard deviation, let's first annualize the daily variance. To annualize the variance, we add  $\sigma_D^2$  252 times, or more simply multiply it by 252.  $\sigma_{D,\text{year}}^2 = 252 \times \sigma_D^2$

The standard deviation is the square root of the variance, which is

$$\sqrt{252 \times \sigma_D^2},$$

or just  $\sqrt{252} \times \sigma_D$

In other words:

$$\sigma_{D,\text{year}} = \sqrt{252} \times \sigma_{D,\text{day}}$$

If we combine the annualization factors of the numerator and denominator, then

$$\frac{252}{\sqrt{252}}$$