

# Backtesting Algorithmic Trading

FinTech

Lesson 14.2



# Class Objectives

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By the end of this lesson, you will be able to:



Describe what implies to backtest an algorithmic trading strategy.



Construct a dual moving average crossover trading signal strategy for both a long and short-position strategy.



Evaluate the performance of a trading algorithm by using backtesting and risk/reward characteristics.



Use the **FinTA** Python library to incorporate different technical indicators as trading signals in an algorithm.

The background is a dark charcoal gray with a series of parallel diagonal lines running from the top-left to the bottom-right. Overlaid on this are several teal-colored geometric shapes: a large central triangle pointing right, a smaller triangle to its left, and a square to its right. Scattered around these shapes are various white line-art symbols, including a plus sign, a minus sign, a circle with a dot, a circle with a horizontal line, a circle with a vertical line, a circle with a diagonal line, a circle with a cross, a circle with a dot, a circle with a horizontal line, a circle with a vertical line, a circle with a diagonal line, a circle with a cross, a circle with a dot, a circle with a horizontal line, a circle with a vertical line, a circle with a diagonal line, and a circle with a cross.

**WELCOME**

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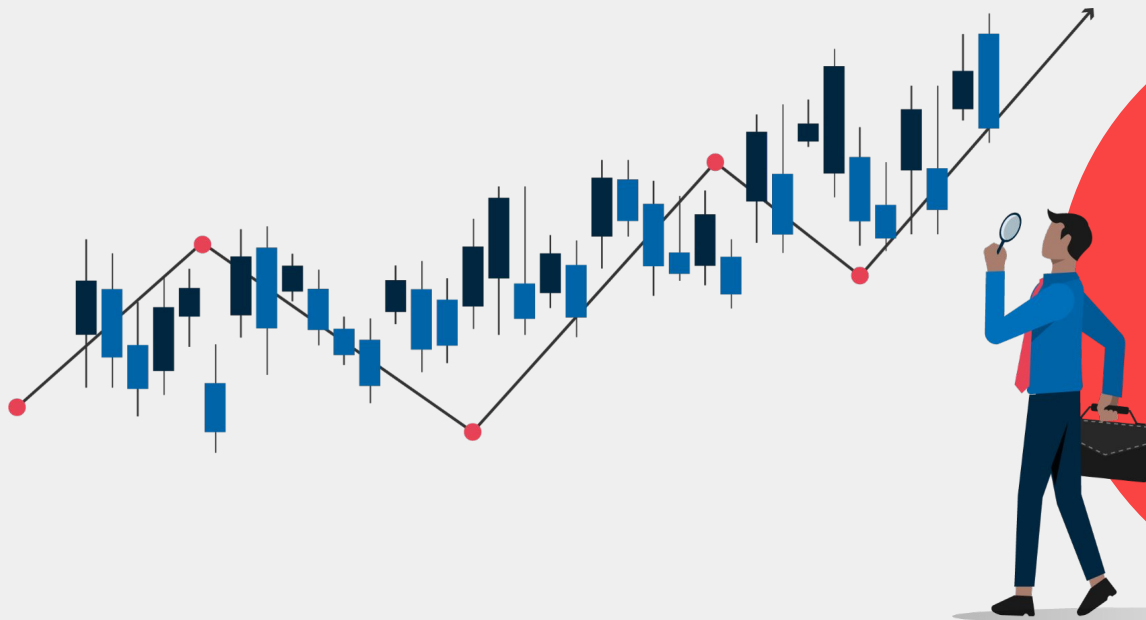
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# Introduction to Backtesting

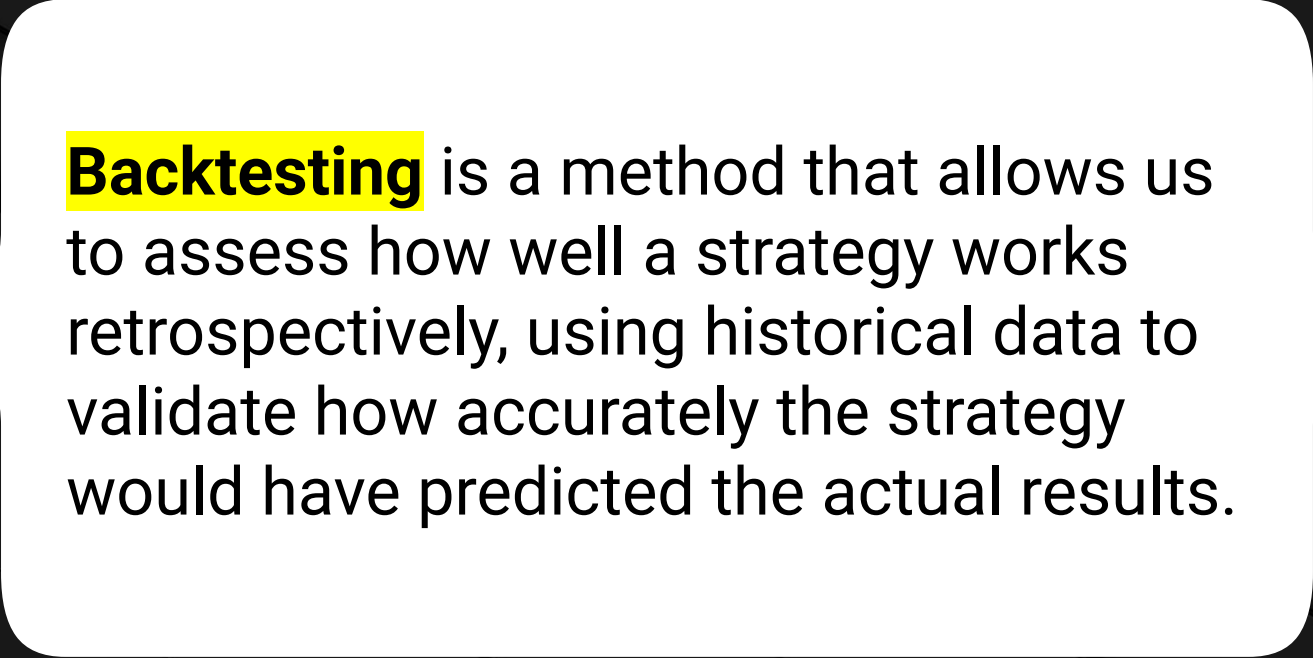
# Introduction to Backtesting

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Algorithmic trading has become common and widely available across the financial world. But deciding what strategy to use may be a challenging task for financial analyst due to the enormous number of trading algorithms that can be used.



To help on deciding what algorithmic trading strategy could be the best for a particular portfolio, we can use **backtesting**.



**Backtesting** is a method that allows us to assess how well a strategy works retrospectively, using historical data to validate how accurately the strategy would have predicted the actual results.

# Introduction to Backtesting

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Although we can backtest and apply a trading algorithm to essentially anything that's tradeable—whether it's stocks, bonds, or crypto—, no single trading strategy works for every individual or situation.

Stocks

Bonds

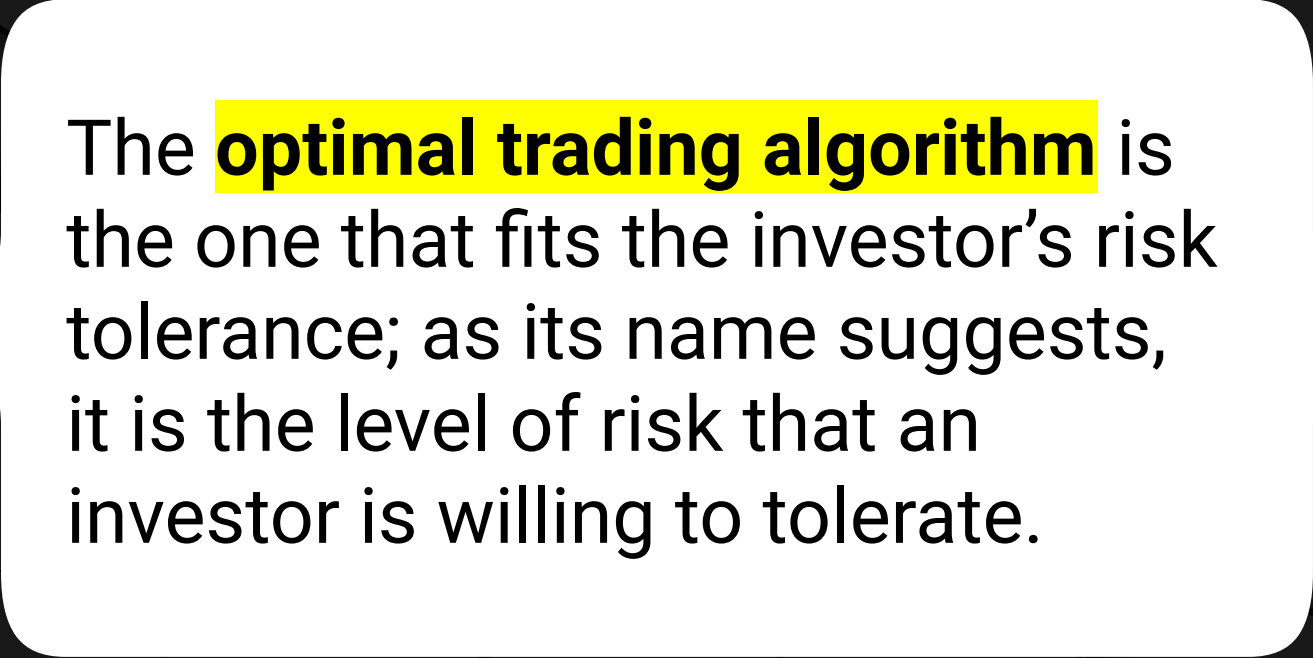
Crypto







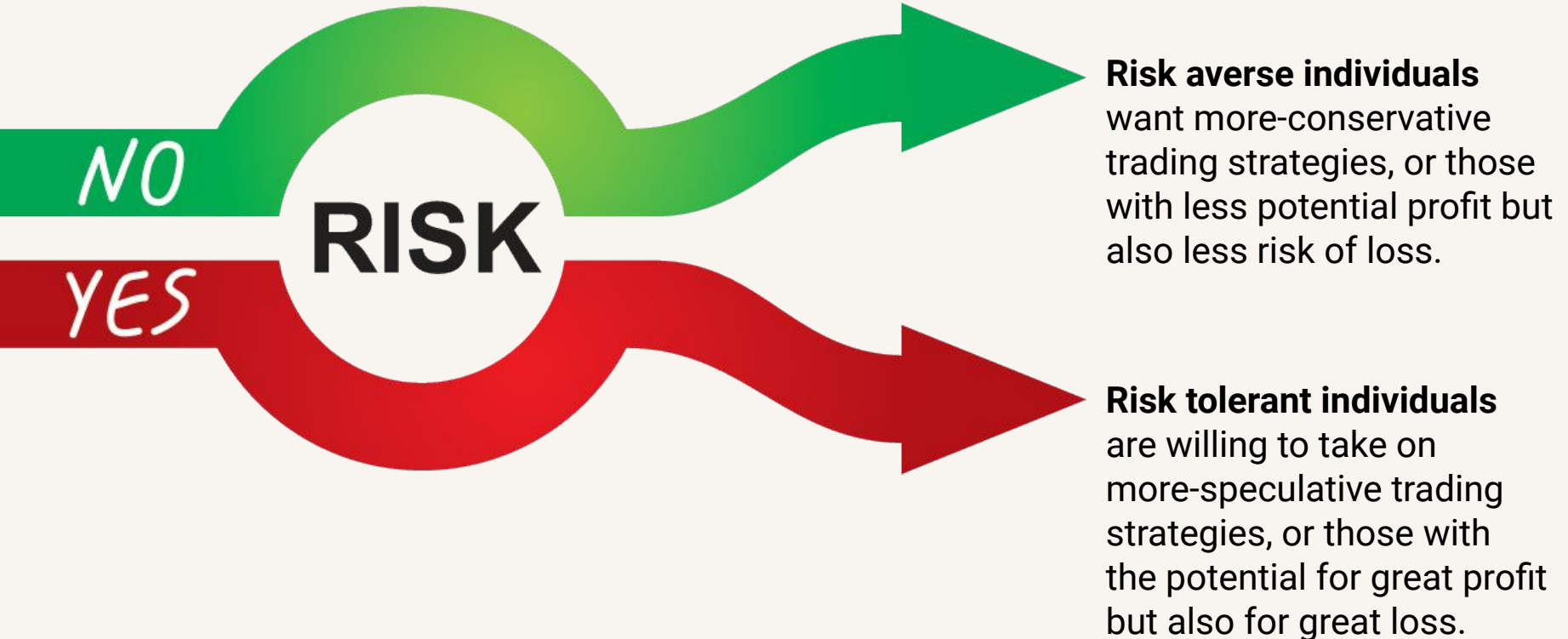
What's an optimal trading algorithm?



The **optimal trading algorithm** is the one that fits the investor's risk tolerance; as its name suggests, it is the level of risk that an investor is willing to tolerate.

# Risk Tolerance

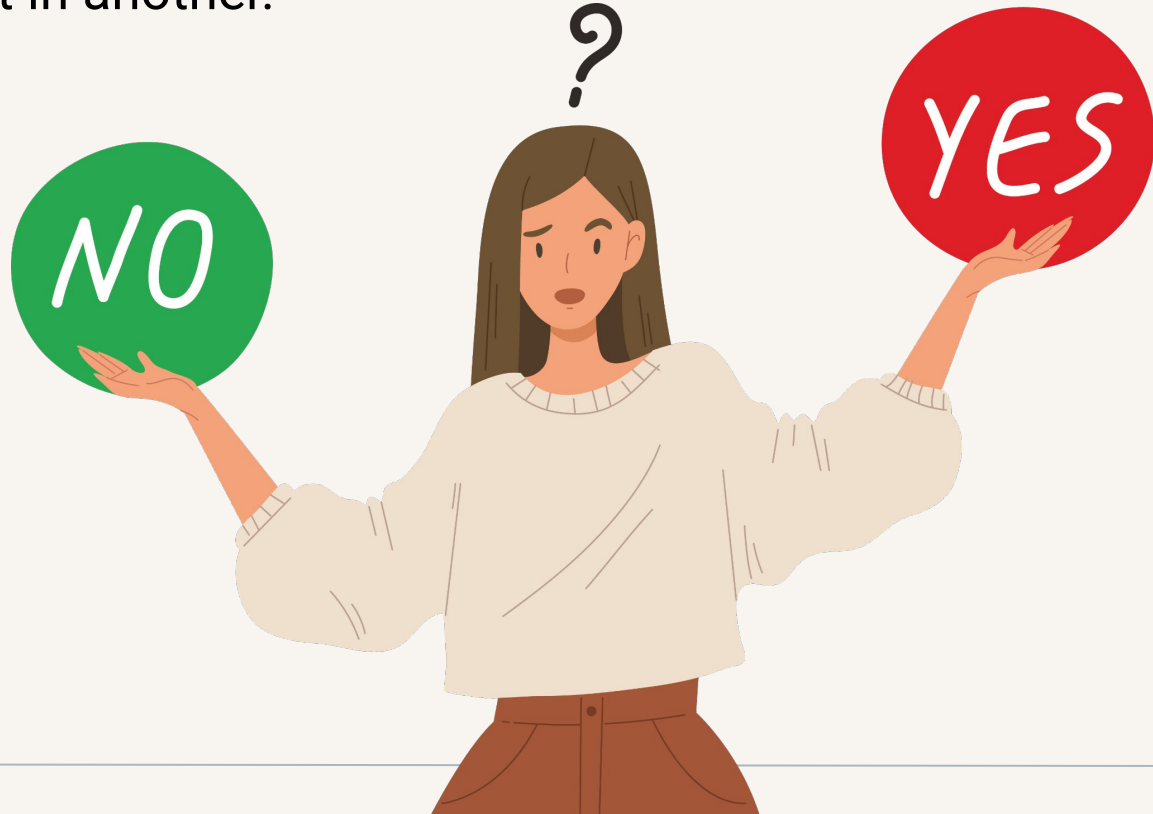
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# Risk Tolerance

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An individual might also feel more risk averse in one situation and more risk tolerant in another.



# Risk Tolerance Examples

You might treat your retirement account differently than the short-term account that you use to fund your day-to-day living expenses.

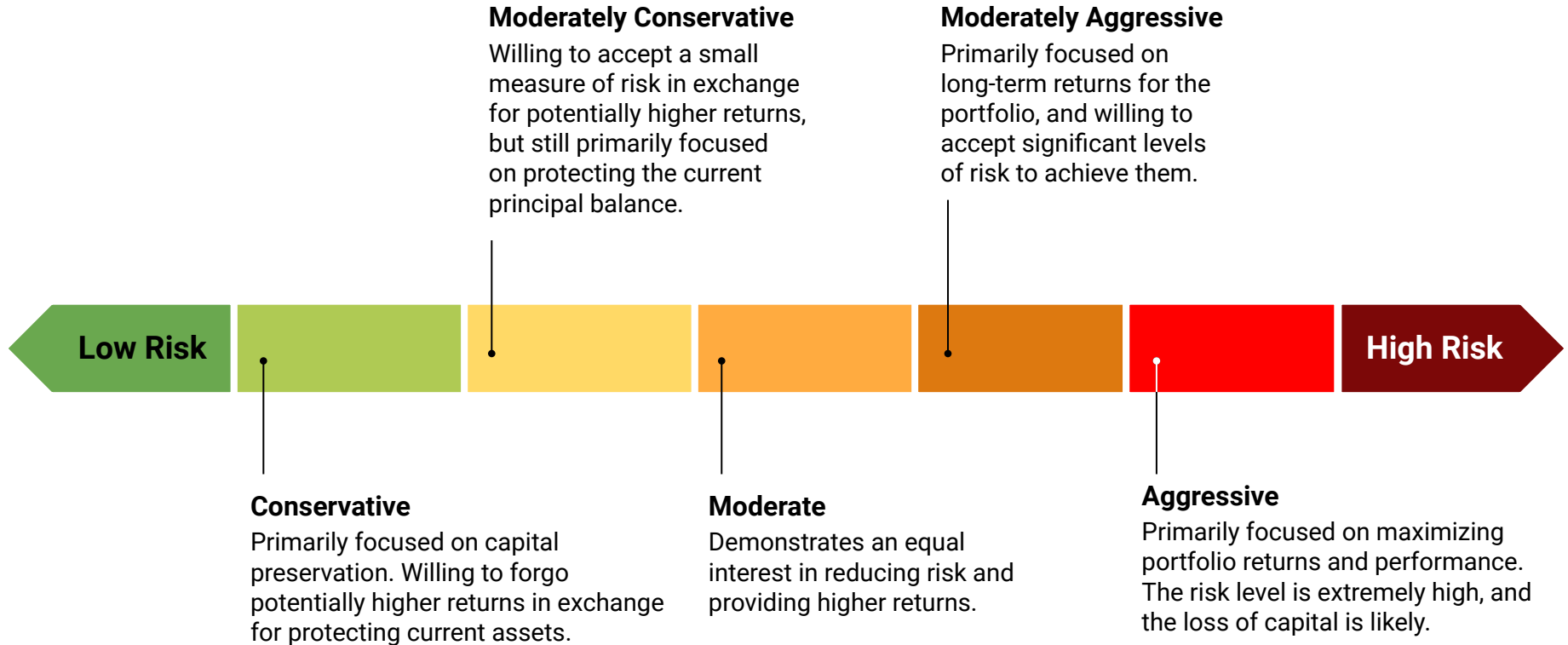
You may want to take more risk with your retirement account if a long time will elapse until you'll need the funds.

If you need the funds from your short-term account to pay the mortgage or rent next month, you won't have time to make up for potential investment losses.



# Risk Tolerance Scale

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# Risk Tolerance

A financial advisor usually discovers a customer's risk tolerance and then determines a trading strategy appropriate for the customer's needs. We can take similar steps for algorithmic trading.

01

We evaluate a trading algorithm to determine its risk/reward characteristics.

02

We determine whether the algorithm meets our needs.



# Questions?







# Instructor Demonstration

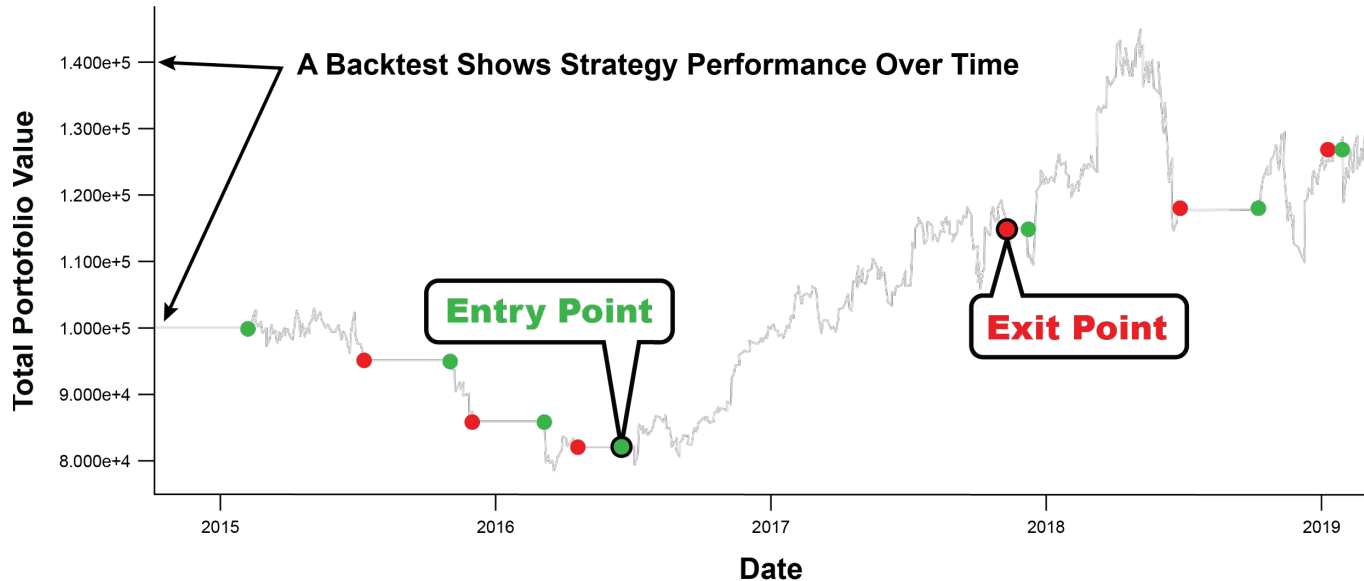
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## Backtesting a Trading Algorithm

# Risk Vs. Reward

# Risk Vs. Reward

Backtesting helps gauge an algo strategy's risk/reward characteristics. It also supplies a standardized baseline for assessing the relative performance of different trading algorithms.



# Risk Vs. Reward

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In order to backtest a trading algorithm, we feed it historical stock data to analyze its trading performance and its risk/reward characteristics for a hypothetical portfolio.

Traders	Use backtesting to compare the viability of trading strategies that they might employ, as well as to tweak successful strategies.
Analysts	Use backtesting as a way to test and compare various trading techniques that might be used in a large investment portfolio.



## Activity: Backtest Your Short-Position Algorithm

In this activity, you'll backtest an algorithm to determine both the changes to the overall portfolio values and the daily return and cumulative return metrics.

Suggested Time:

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20 Minutes



Time's Up! Let's Review.

# Questions?



# Assessing the Risk/Reward Characteristics of a Trading Algorithm



# Risk/Reward Characteristics of a Trading Algorithm

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There are two considerations that should be done when we backtest a trading algorithm:



# Past vs. Future Performance

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When we backtest a trading algorithm, the results are based on historical data.



This means that backtesting might demonstrate that the algorithm would have been profitable in the past.



However, it doesn't guarantee how the algorithm will perform in the future.



An algorithmic trading strategy that's designed to succeed with past data might not work with future data.

# Risk/Reward Management

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Due to the inherent uncertainty about future profitability, the golden rule of trading is to use risk/reward management.



Since future market conditions are unknowable, traders should make investments only when they feel comfortable with the level of risk that's required for achieving a certain level of profit.



Before deploying a trading algorithm, we need to analyze the algorithm's overall risk/reward characteristics at both the portfolio and per-trade level.



The risk/reward characteristics of a trading strategy can be understood as the amount of risk, or the potential loss, that a person assumes for an investment with the expectation of returning a gain, or an expected amount of profit.



# Instructor Demonstration

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Generating the Risk/Reward Evaluation Metrics

# Risk/Reward Metrics

These metrics can be calculated historically with backtesting, or they can be used to measure future trades and opportunities for portfolio growth.

	Definition	Implementation
<b>Annualized Return</b>	We calculate it by first averaging the daily return values over the time period of the dataset.	We then multiply that average daily return value by 252, or the number of trading days in a year.
<b>Cumulative Returns</b>	The aggregate percentage return (that is, the percentage gain or percentage loss) for an investment.	We usually measure the cumulative return across the entire investment rather than for a particular time period.
<b>Annual Volatility</b>	The amount that each daily return value differs from the asset's average daily return value (that is, the standard deviation of the asset's daily return values), measured on an annualized basis.	The annual volatility helps determine the amount that the stock will potentially gain or lose vs. the expected amount, over a single year.

# Risk/Reward Metrics, continued

	Definition	Implementation
<b>Sharpe Ratio</b>	A measurement of an asset's outperformance as compared to the asset's volatility. The outperformance is measured by the difference between the asset's ROI and the return expected from an asset assumed to have no risk, like a three-month US Treasury bill. (Because three-month Treasury bill returns are, these days, zero, we usually just exclude this last term from the formula.)	The asset's volatility is characterized by the standard deviation of its daily return values.
<b>Sortino Ratio</b>	A variation of the Sharpe ratio that differentiates an asset's harmful volatility from its overall volatility. The Sharpe ratio measures an investment's ROI vs. its volatility, treating positive or negative results the same way. By contrast, the <a href="#">Sortino ratio</a> focuses on the <b>downside standard deviation</b> , which measures the downside volatility of the asset.	The distinction has relevance, because investors tend to have more concern about negative surprises than positive ones.

# Columns of the `trade_evaluation` DataFrame.

<b>Stock</b>	The name of the asset that we're trading
<b>Entry Date</b>	The date that we entered (bought) the trade.
<b>Exit Date</b>	The date that we exited (sold) the trade.
<b>Shares</b>	The number of shares that we executed for the trade.
<b>Entry Share Price</b>	The price of the asset when we entered the trade.
<b>Exit Share Price</b>	The price of the asset when we exited the trade.
<b>Entry Portfolio Holding</b>	The cost of the trade on entry (which is the number of shares multiplied by the entry share price).
<b>Exit Portfolio Holding</b>	The proceeds that we made from the trade on exit (which is the number of shares multiplied by the exit share price).
<b>Profit/Loss</b>	The profit or loss from the trade (which is the proceeds from the trade minus the cost of the trade).

# Questions?







# Activity: Evaluating Your Short-Position Algorithm

In this activity, you'll evaluate the risk/reward characteristics of the short-position strategy that you created before.

Suggested Time:

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25 Minutes



Time's Up! Let's Review.

# Questions?





Break



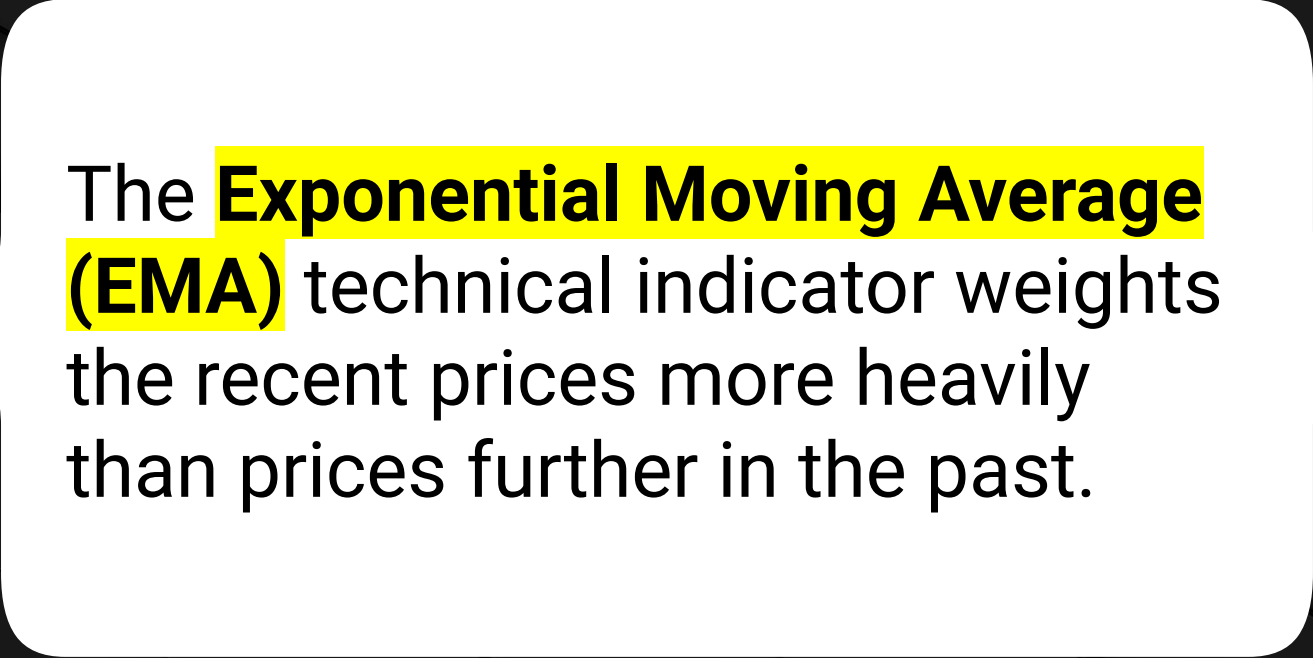
# Instructor Demonstration

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## Alternative Technical Indicators



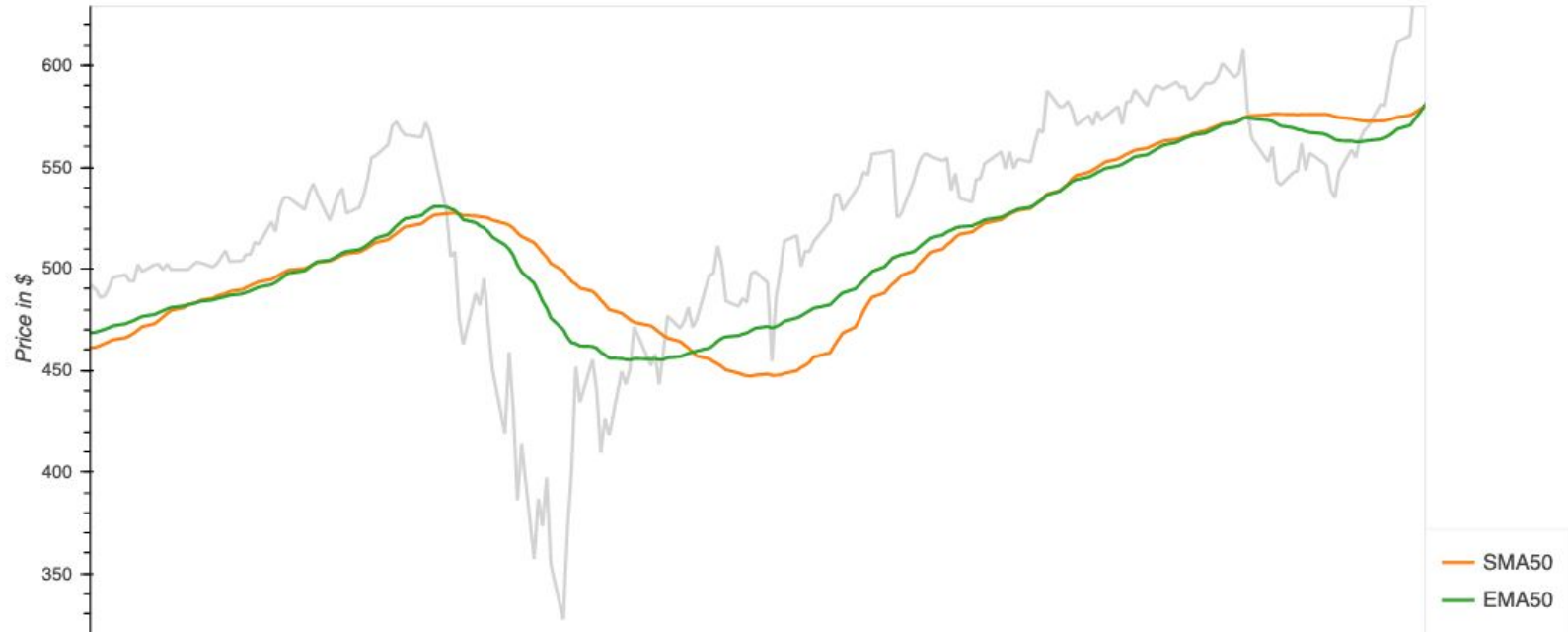
**A close relative to the simple moving average (SMA) technical indicators that were just utilized is the Exponential Moving Average (EMA).**



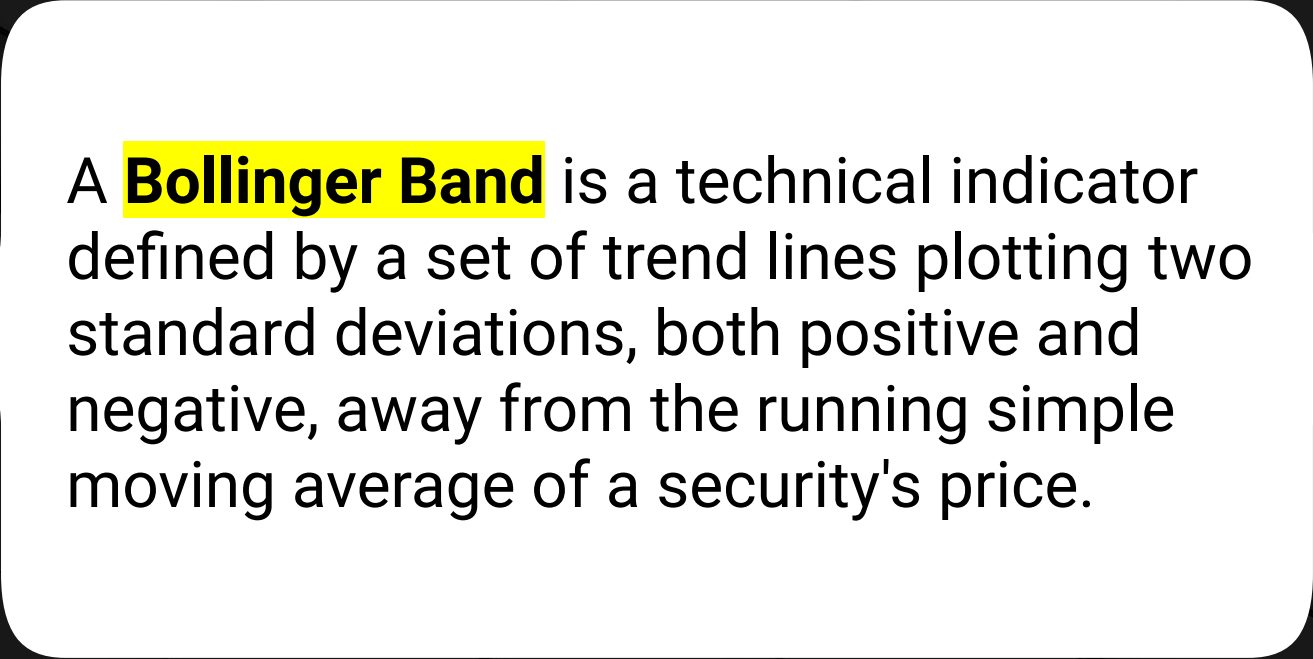
The **Exponential Moving Average (EMA)** technical indicator weights the recent prices more heavily than prices further in the past.

# SMA versus EMA

A long-position dual moving average crossing over trading algorithm can be built by simply replacing the SMA technical indicators with EMA technical indicators.







A **Bollinger Band** is a technical indicator defined by a set of trend lines plotting two standard deviations, both positive and negative, away from the running simple moving average of a security's price.

# Bollinger Bands

Bollinger Bands help to identify when an asset is either overbought (i.e., at an unusually high price) or oversold (unusually low).





# Activity: Using FinTA for Trading Signals

In this activity, you'll utilize the **FinTA** Python library to generate the technical indicator values used in several trading algorithms.

Suggested Time:

25 Minutes



Time's Up! Let's Review.

# Questions?





**Now that we are able to create a variety of trading algorithms using different technical indicators, how do we go about evaluating them?**



The next step in the process is to backtest the various trading algorithms using evaluation metrics such as per-trade profit and loss as well as risk metrics like annualized volatility and the Sharpe/Sortino ratio.

*The  
End*