Track to the Future!

FinTech

Lesson 5.3

Class Objectives

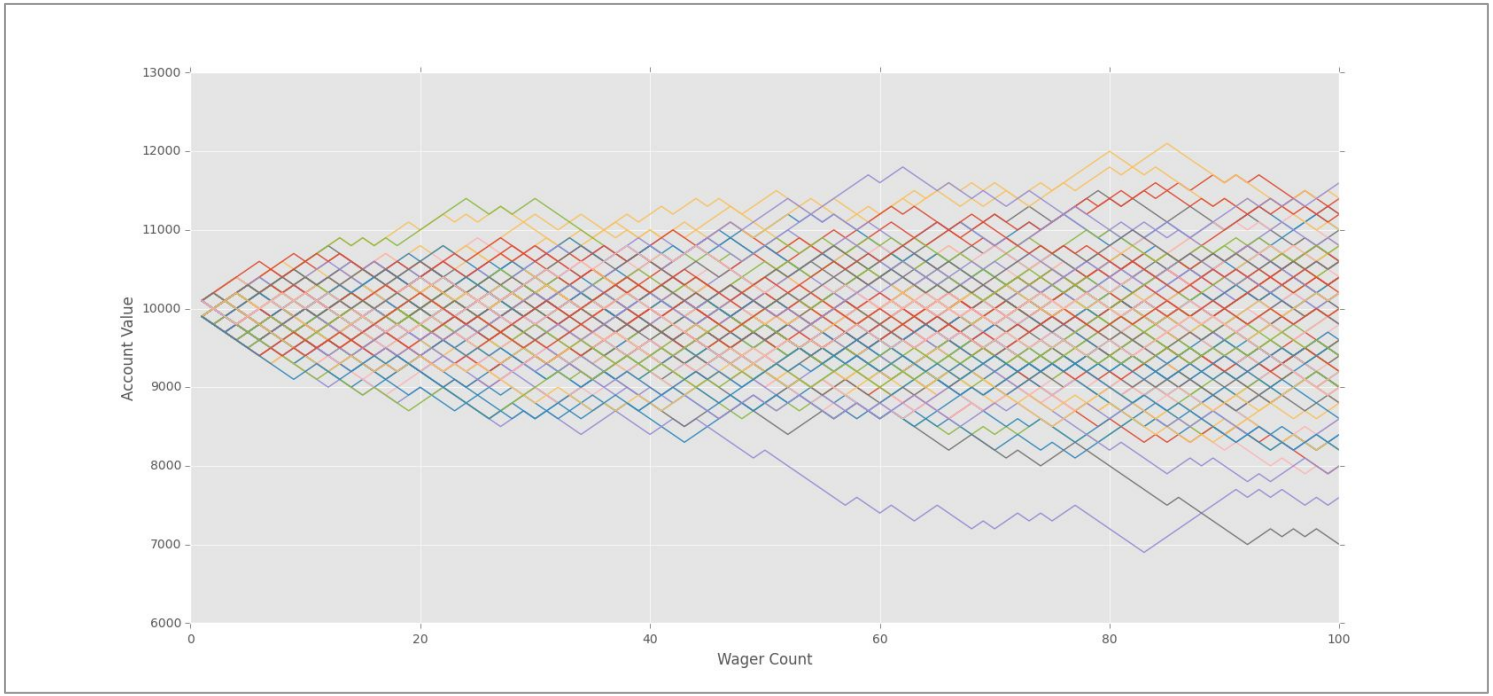
By the end of today's class, you will be able to:

- Define what a simulation is and why it's used.
- Deconstruct the Monte Carlo simulation process: probability distributions and iterations.
- Interpret probability distributions (normal, bell curve) and random number generators.
- Comprehend the use of confidence intervals and what they suggest.
- Implement a single Monte Carlo simulation on the price trajectory of a stock.
- Execute multiple Monte Carlo simulations on the price trajectories of a stock.
- Break down portfolio forecasting: Monte Carlo simulations on stock price & portfolio returns.
- Implement multiple Monte Carlo simulations on the potential returns of a stock portfolio.

Monte Carlo Simulations

Monte Carlo Simulations

Today we will combine what we've learned so far on using APIs to pull in stock data and forecast single stock/portfolio returns using Monte Carlo simulations.

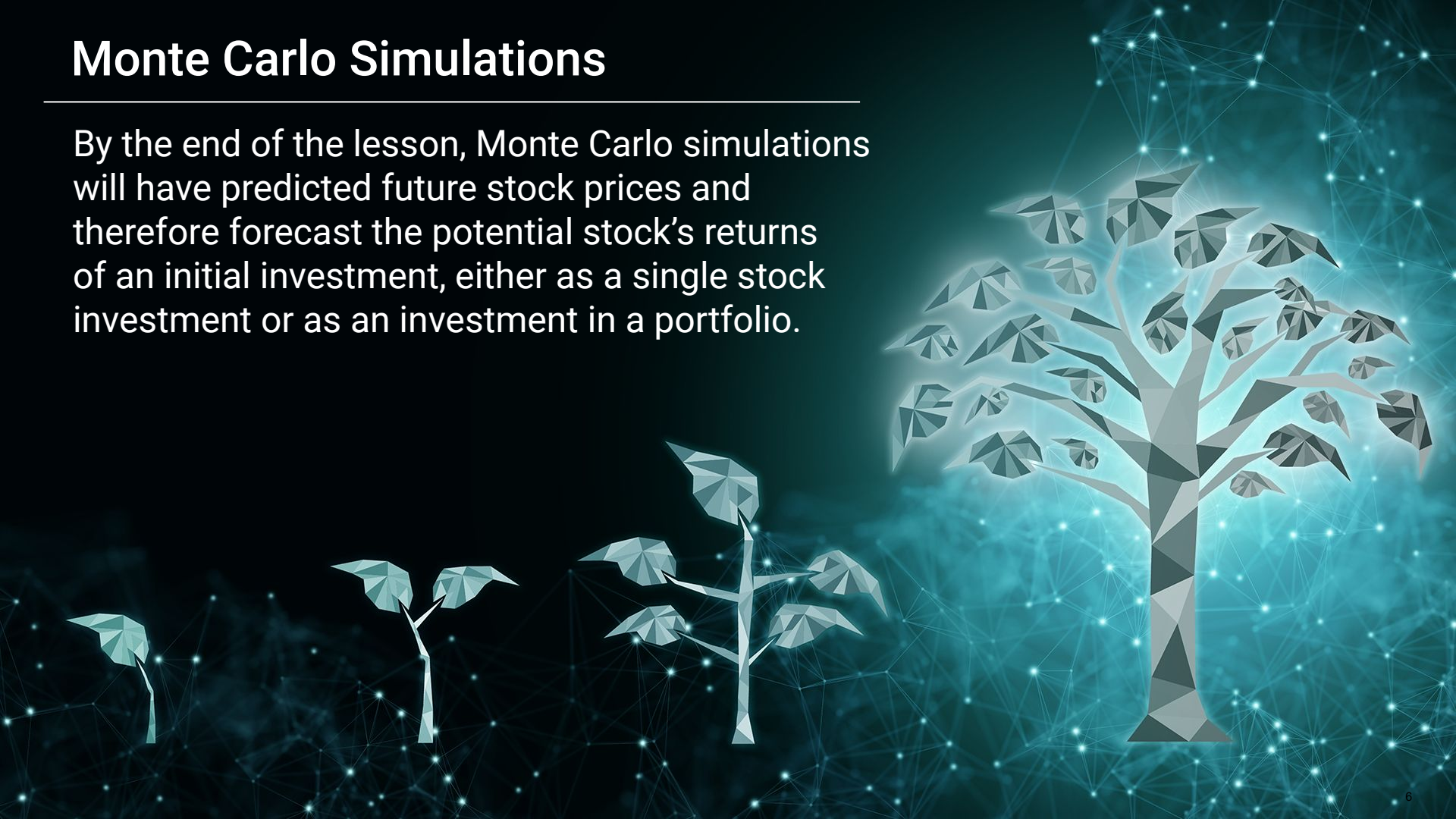


Monte Carlo Simulations

Simulations will require a switch from historical analysis to predicting the future.

Monte Carlo Simulations

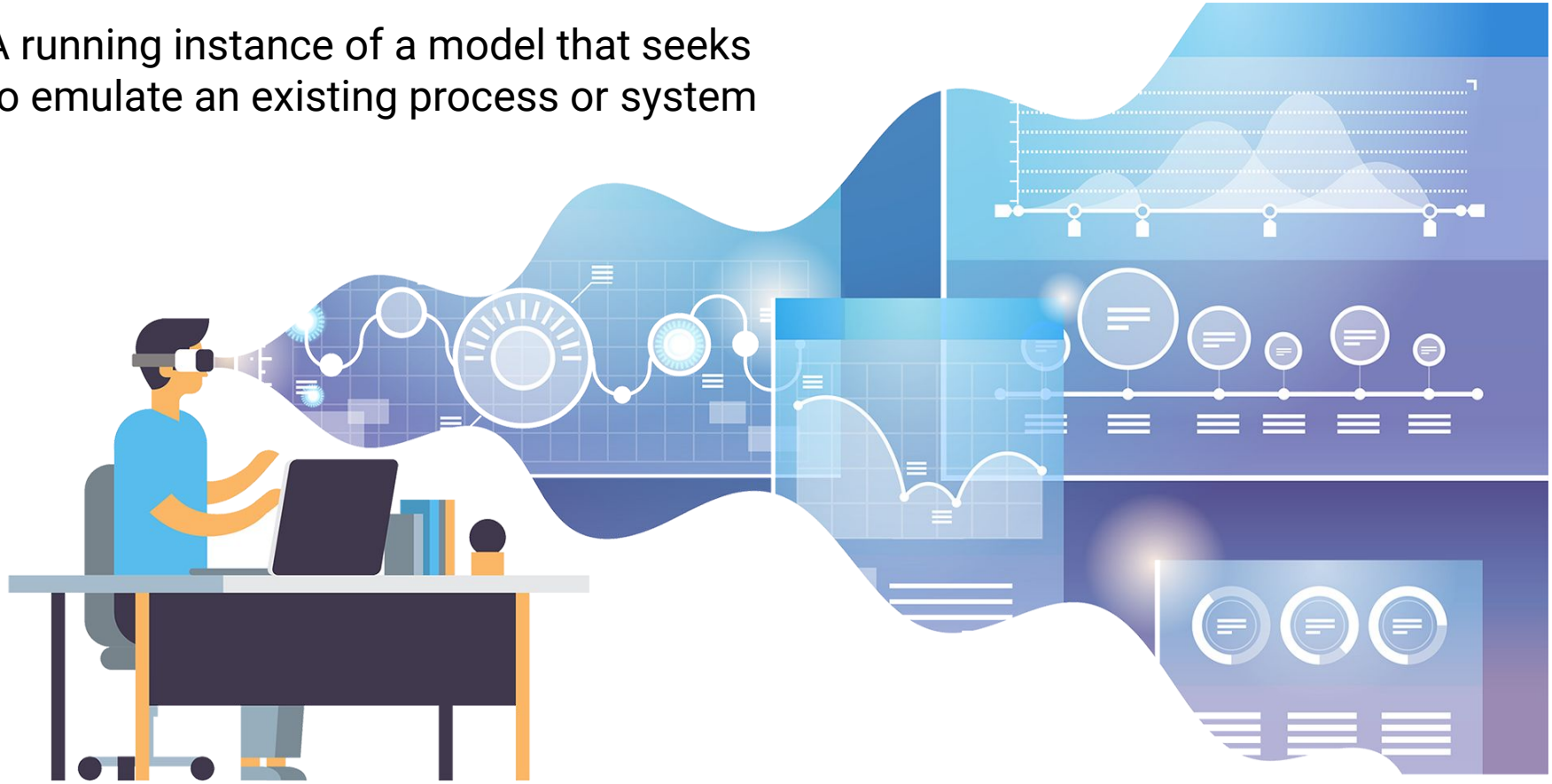
By the end of the lesson, Monte Carlo simulations will have predicted future stock prices and therefore forecast the potential stock's returns of an initial investment, either as a single stock investment or as an investment in a portfolio.



Simulations

What are simulations?

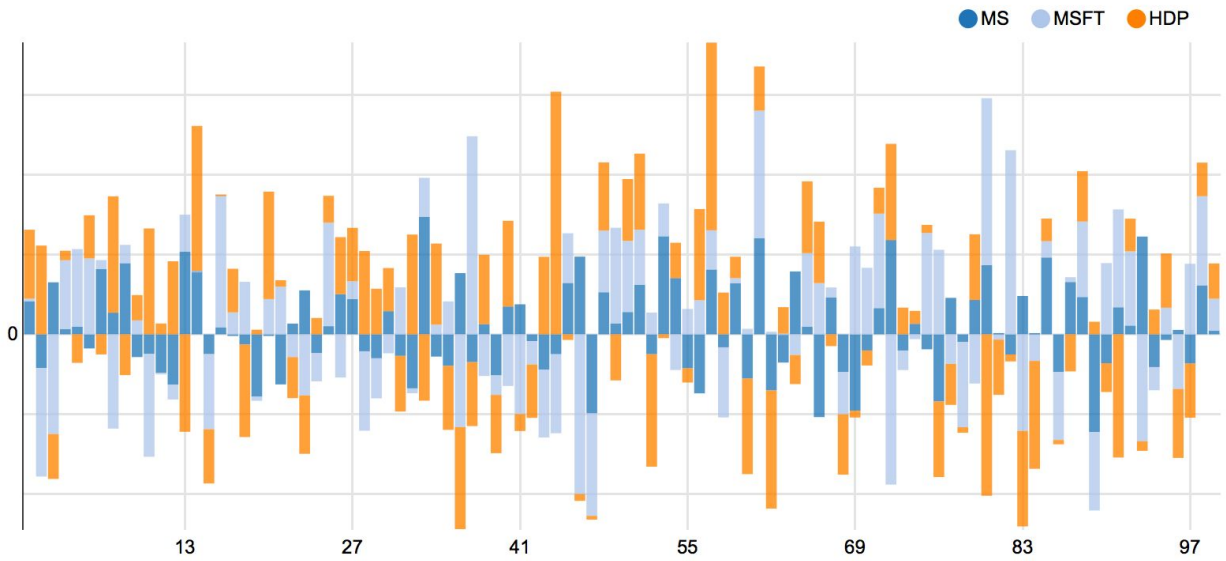
A running instance of a model that seeks to emulate an existing process or system



What are Monte Carlo simulations?

Simulations that use probability and variables to predict the future potential outcomes of a randomly occurring process

Daily Value At Risk (1 Simulation for 100 future days)



VaR Percentiles

percentile	outcome
-1.87%	worst
0.25%	typical
2.15%	best

Why use Monte Carlo simulations?

They help make sense of the risk of uncertainty in prediction and forecasting models, which are particularly helpful when dabbling in the domain of capital investments and stock price uncertainty

Understanding Probability and Probability Distributions

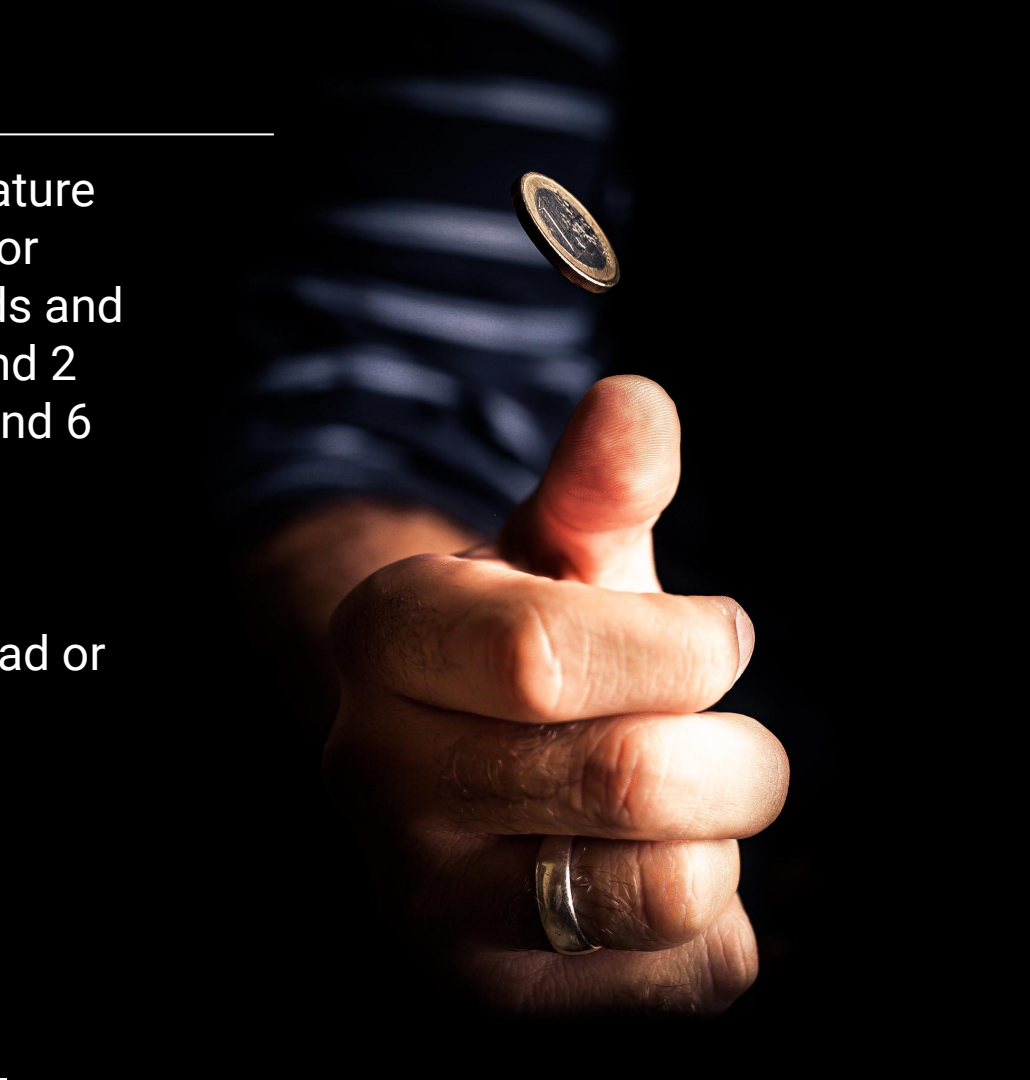
Grasping Probability

Imagine you are a scientist who wants to know how often a coin could land on heads for five trials of ten coin flips. Flipping a coin has a 50% chance of landing on heads and a 50% chance of landing on tails.

Grasping Probability

Because of the randomly occurring nature of flipping a coin, results could vary: for example, a coin could produce 6 heads and 4 tails; 3 heads and 7 tails; 8 heads and 2 tails, 5 heads and 5 tails, or 4 heads and 6 tails.

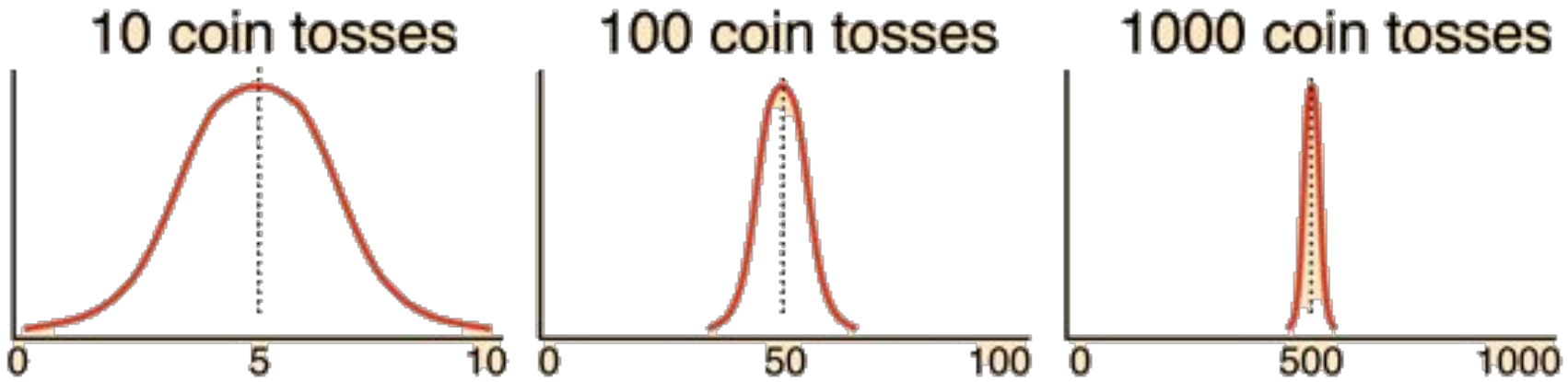
Probability is the chance of an event happening, in this example, having head or tail.



Probability Distribution

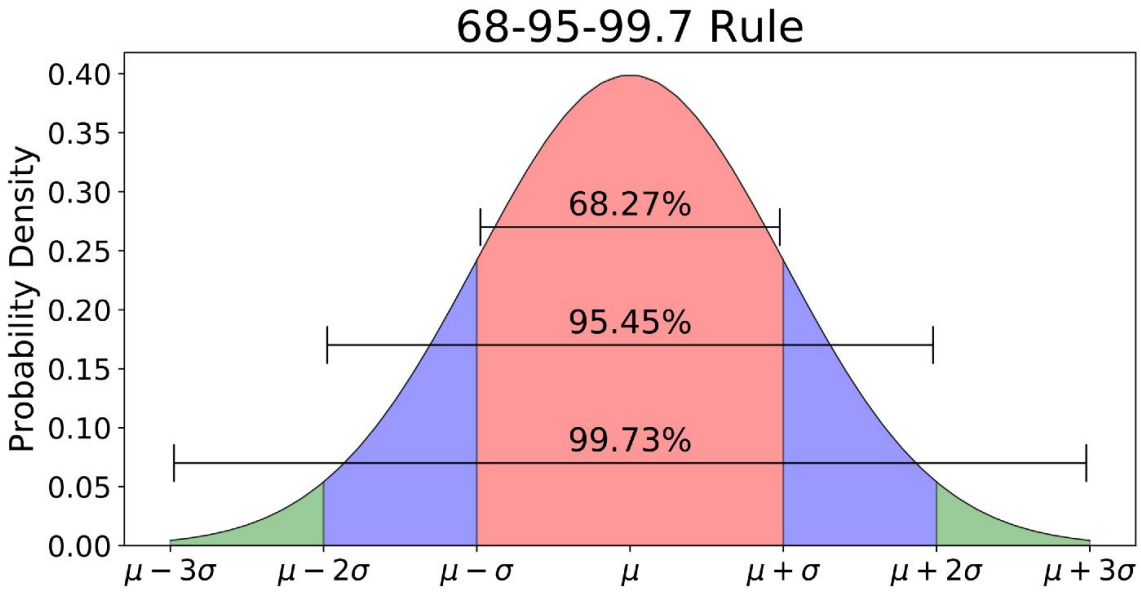
A probability distribution is a mathematical function that describes the likelihood of possible outcomes for a given range of values.

For example we can define a function to calculate the likelihood of getting 7 heads on 10, 100, or 1000 coin flips.



Normal Probability Distributions

These distributions showcase the various probabilities of returning a value based on the number of standard deviations it is from the mean (how far the value may lie plus or minus from the average expected value).

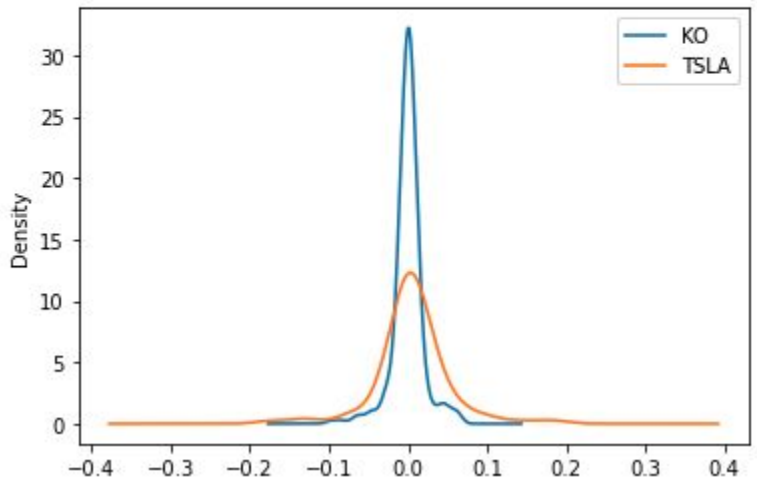


Normal Distributions in Finance

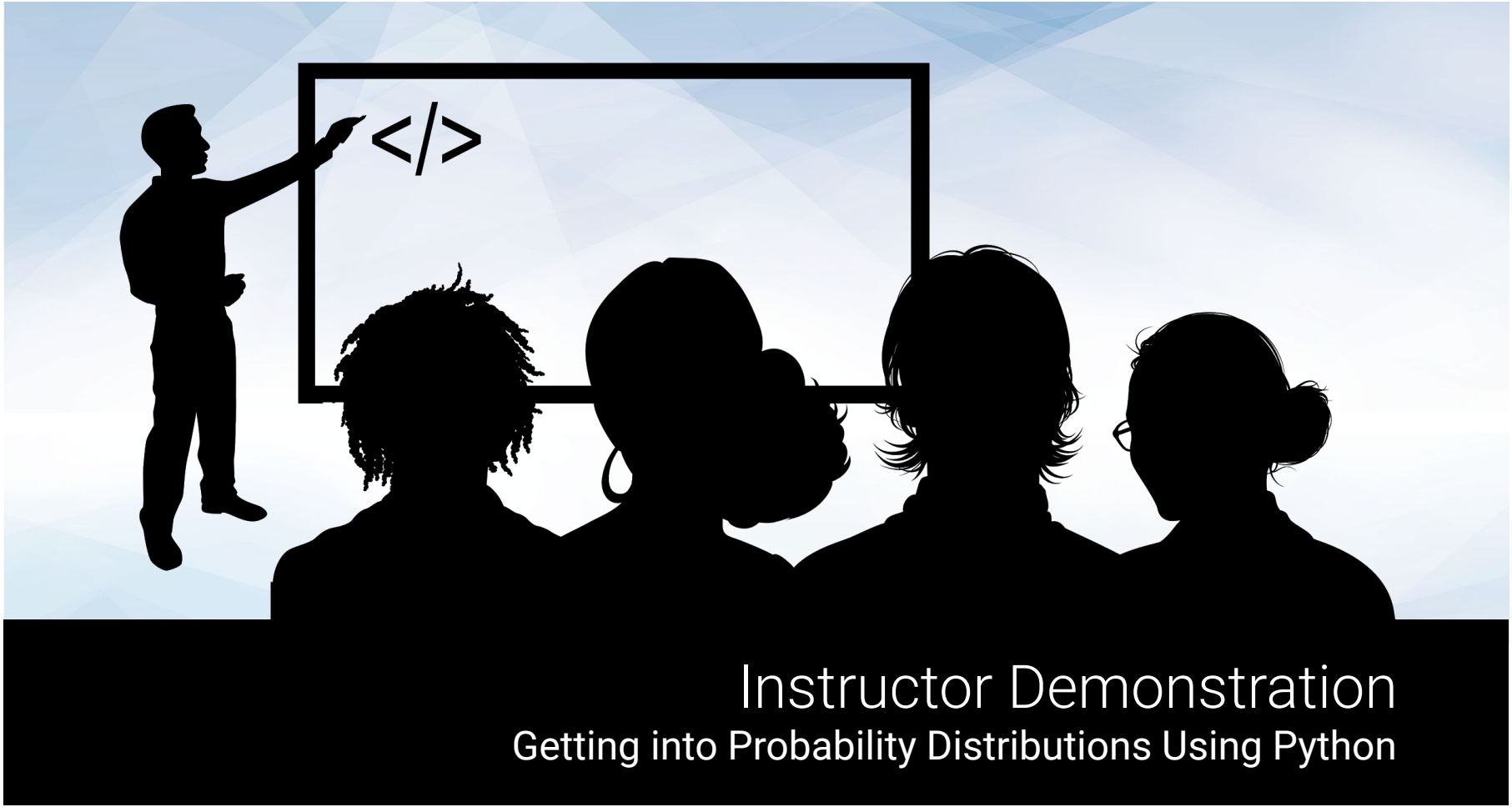
Normal distributions are particularly useful in finance because they adequately approximate the volatility of stock prices, forex rates and other commodities.

```
# Visualize the distribution of percent change in closing price for both stocks using a density plot
df_daily_returns.plot.density()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fa475e35a50>
```

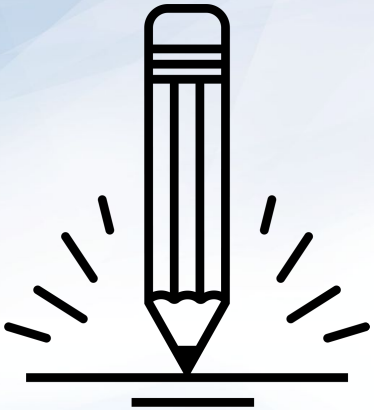


The daily price change (in percent) from a high volatility stock such as Tesla and a low volatility stock such as Coca-Cola can both demonstrate normal distributions.



Instructor Demonstration

Getting into Probability Distributions Using Python



Activity: Decisive Distributions

In this activity you will gain hands-on experience fetching historical stock data and plotting distributions to make investment decisions.
(Instructions sent via Slack.)

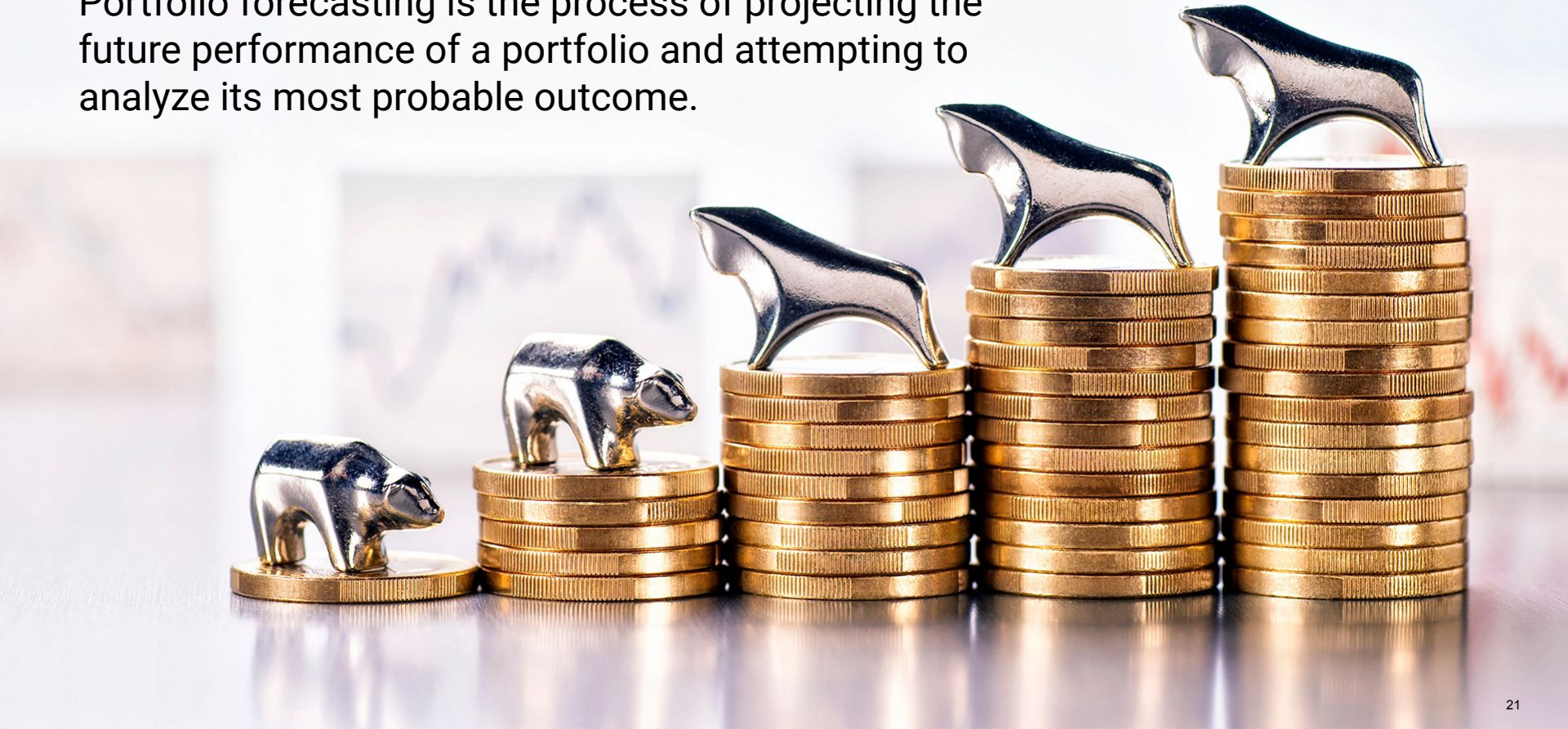
Suggested Time:
20 minutes

Time’s Up! Let’s Review.

Portfolio Forecasting Using Monte Carlo Simulations

What is portfolio forecasting?

Portfolio forecasting is the process of projecting the future performance of a portfolio and attempting to analyze its most probable outcome.



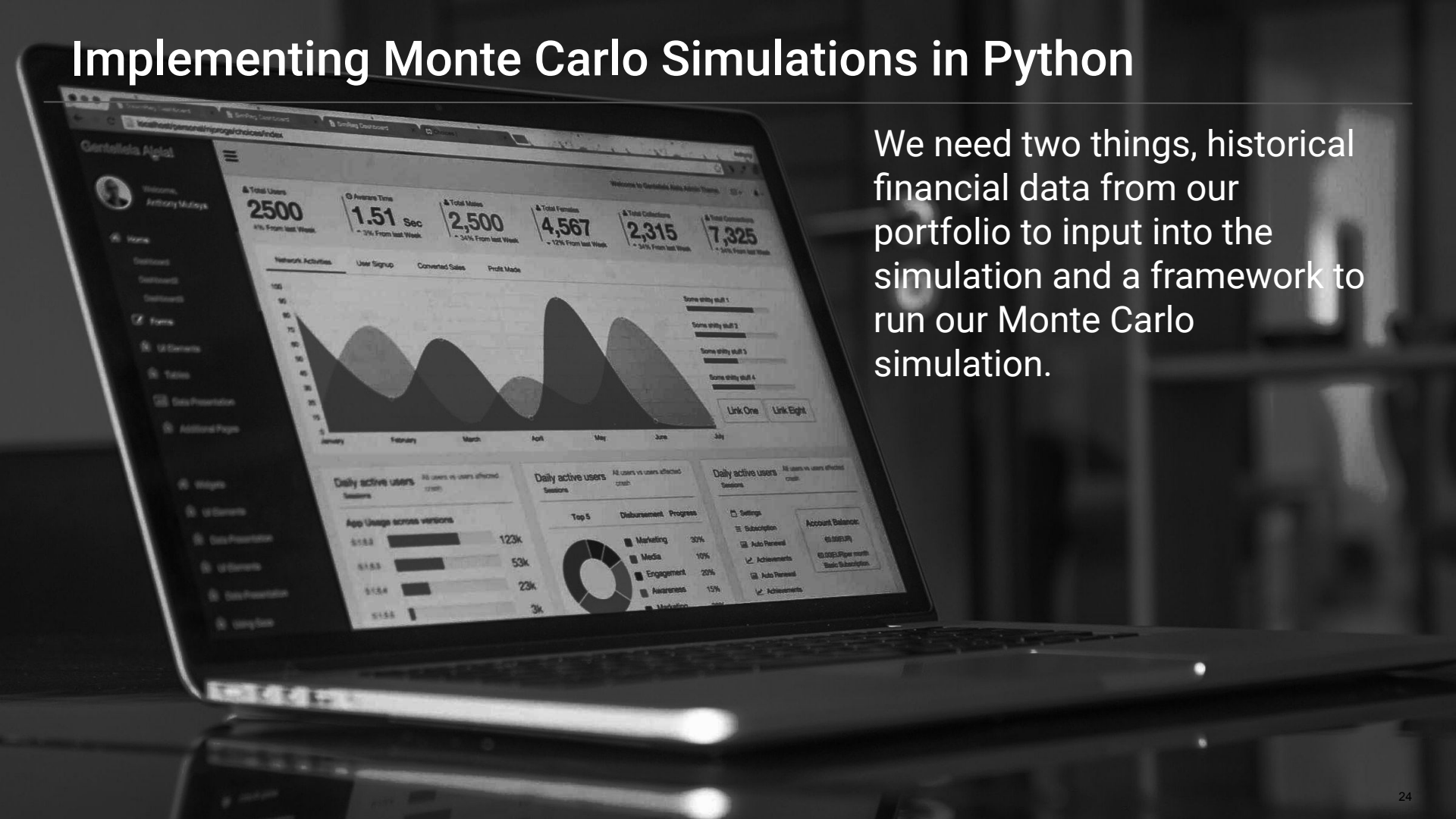
How is portfolio forecasting done?

Similar to the forecasting of a stock's price trajectory, Monte Carlo simulations are applied to forecast the potential price trajectories of the individual stocks that comprise the portfolio.

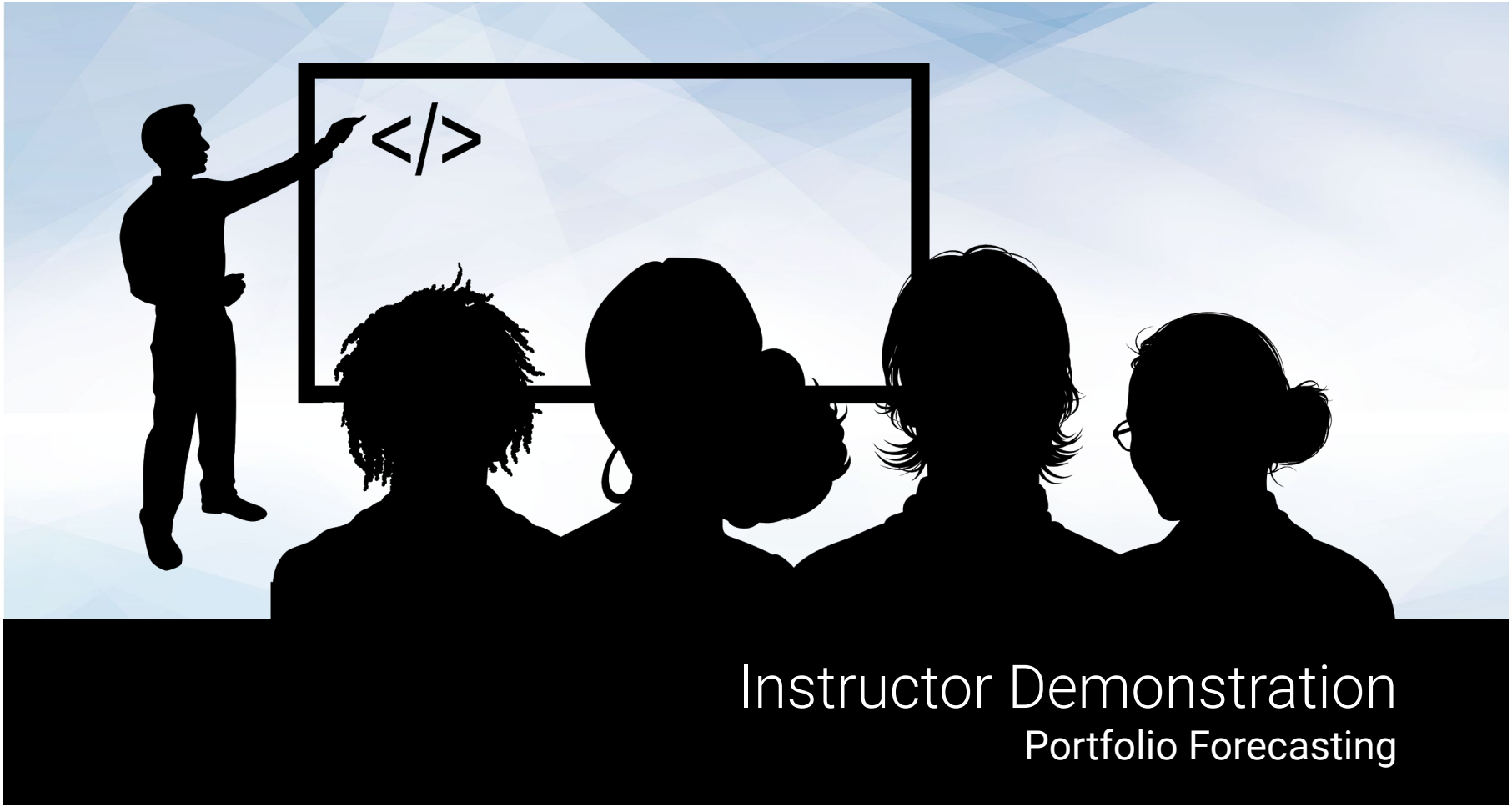
Who is performing portfolio forecasting?

Portfolio managers, quantitative analysts, and retirement planners are just some of many who need to forecast the future performance of a portfolio to gauge the potential risk of investment.

Implementing Monte Carlo Simulations in Python



We need two things, historical financial data from our portfolio to input into the simulation and a framework to run our Monte Carlo simulation.



Instructor Demonstration

Portfolio Forecasting

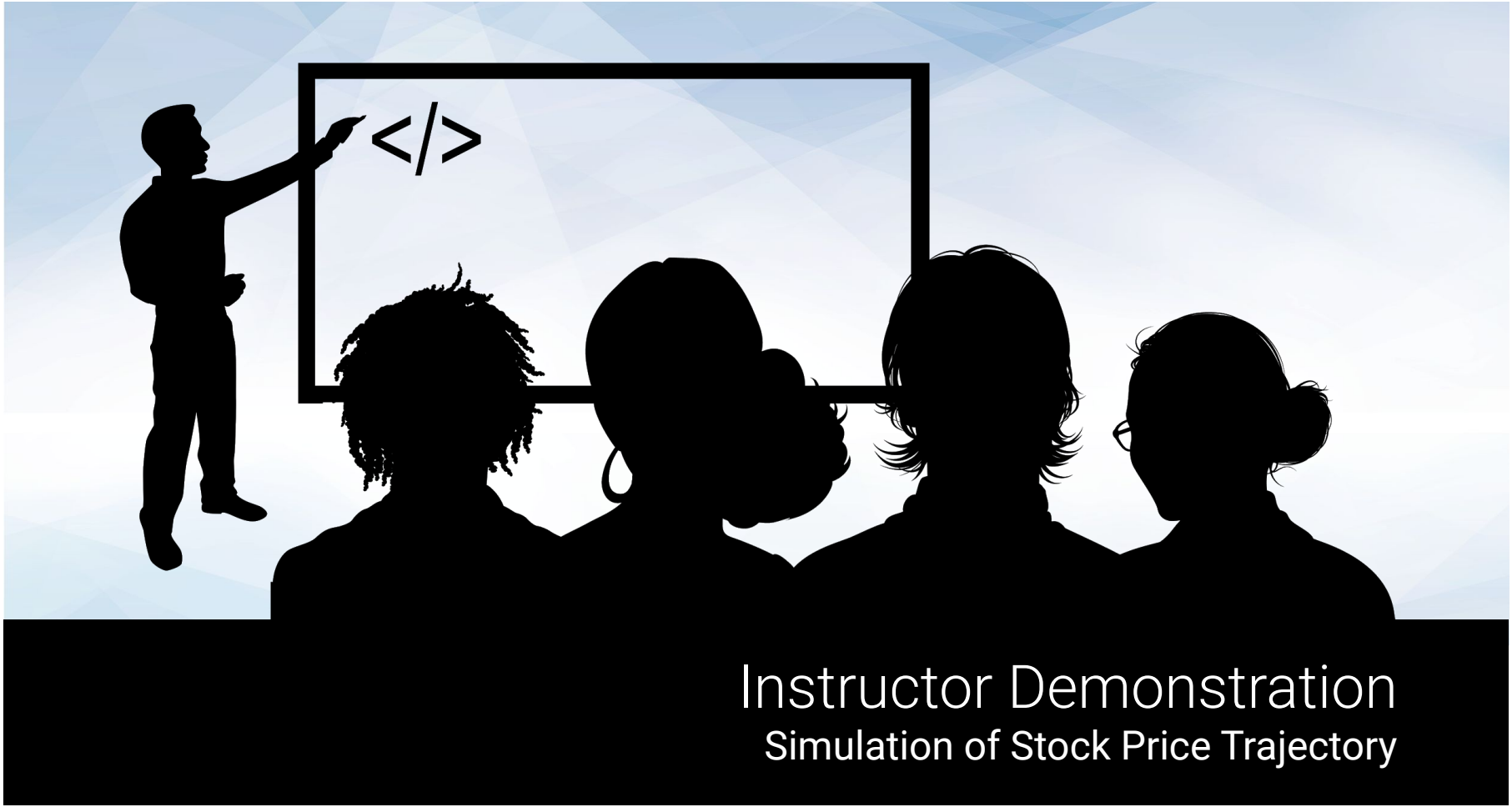

Break

Activity: Three Stock Monte

In this activity you will use the `MCForecastTools` toolkit to determine how much of each stock is worth to purchase in a portfolio in order to maximize your chances of profit.
(Instructions sent via Slack.)

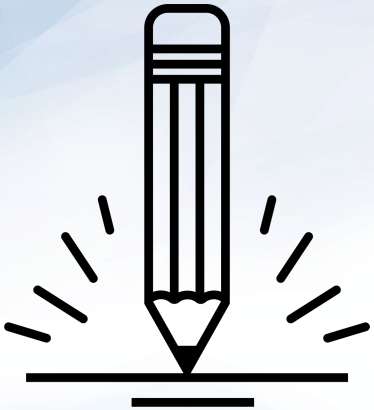
Suggested Time:
30 min

Time’s Up! Let’s Review.



Instructor Demonstration

Simulation of Stock Price Trajectory



Activity: Financial Forecasting

In this activity, you will execute a Monte Carlo simulation to forecast stock price behavior of historical `TSLA` daily returns.
(Instructions sent via Slack.)

Suggested Time:
15 minutes

Time’s Up! Let’s Review.

Questions?


The End.