

Developing Financial Thinking in Academia and Industry

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Manager, Customer Success Engineering

Agenda



Developing Financial Thinking



Why, What, Where



Challenges



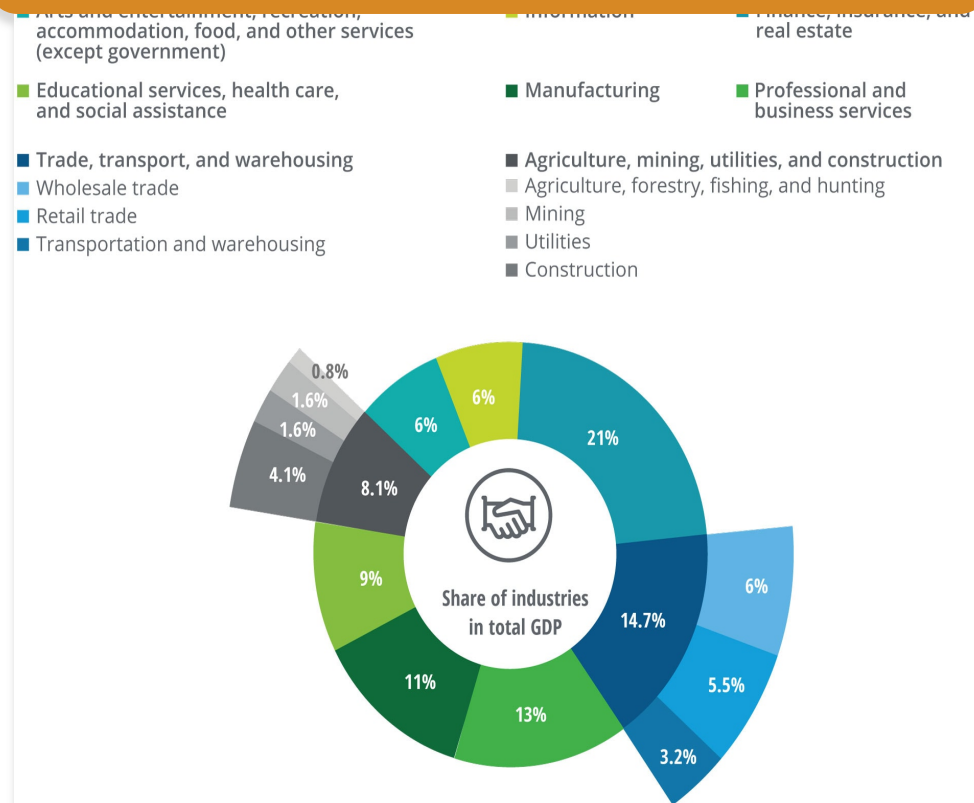
How



Call to Action

Why Develop Financial Thinking

The industry that makes up Wall Street (finance, insurance, and real estate) is the biggest contributor to GDP



Sources: Bureau of Economic Analysis (BEA); Haver Analytics LP.

.Deloitte Insights | deloitte.com/insights

indeed Find jobs Company reviews Find salaries

What **Quantitative** Where

Date Posted Remote Salary Estimate

Experience Level

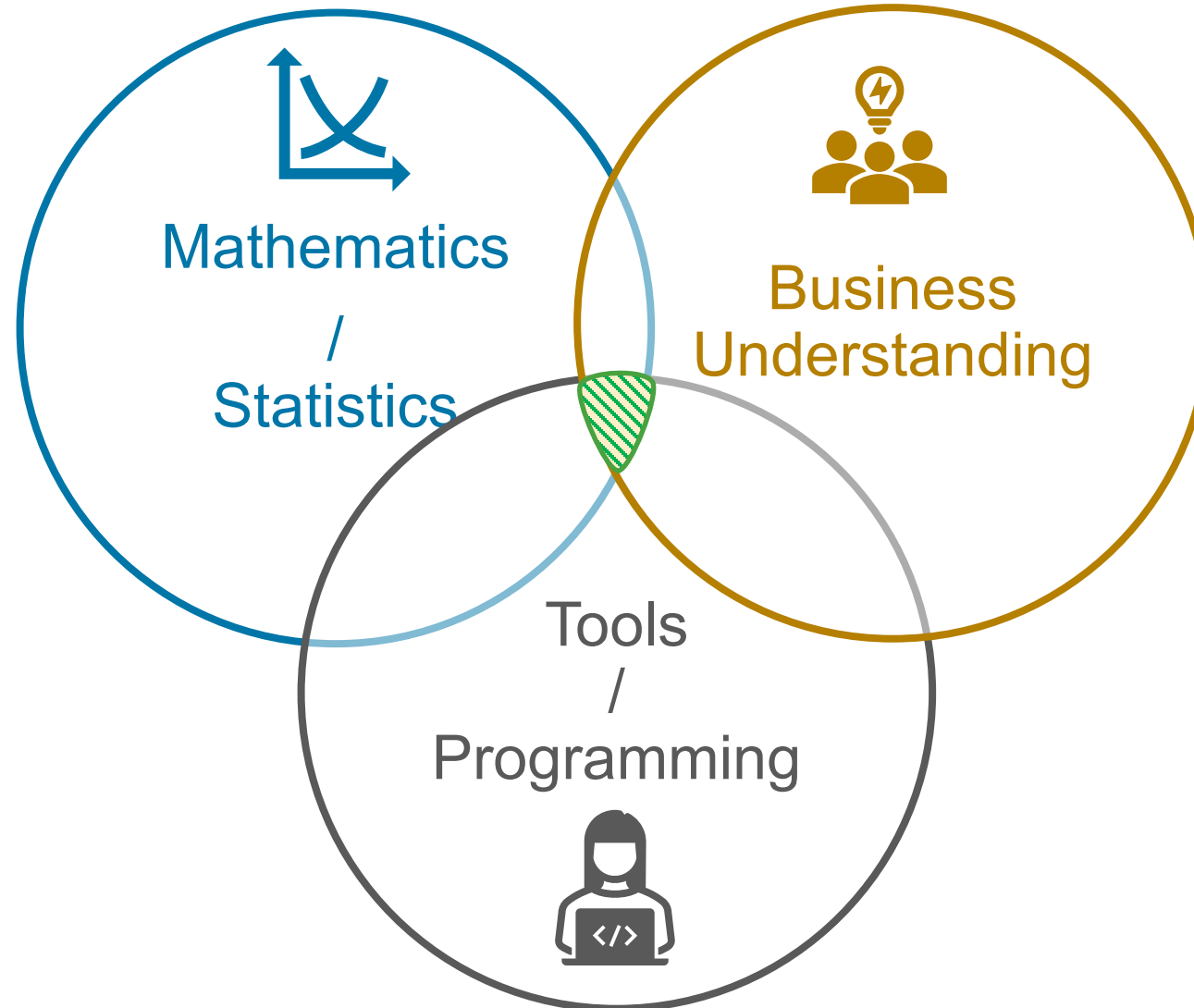
Upload your resume - Let employers find you

Quantitative jobs

Sort by: **relevance** - date Page 1 of 75,195 jobs

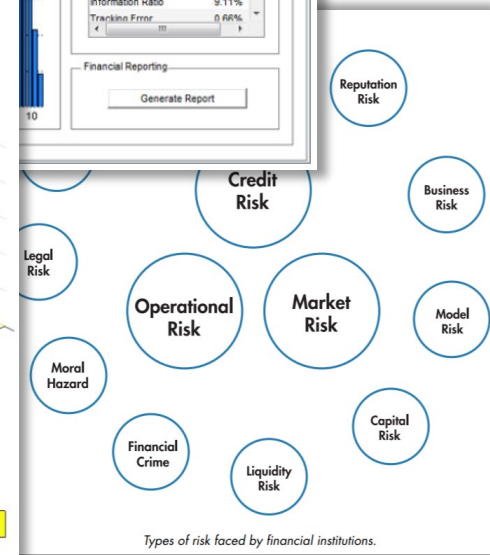
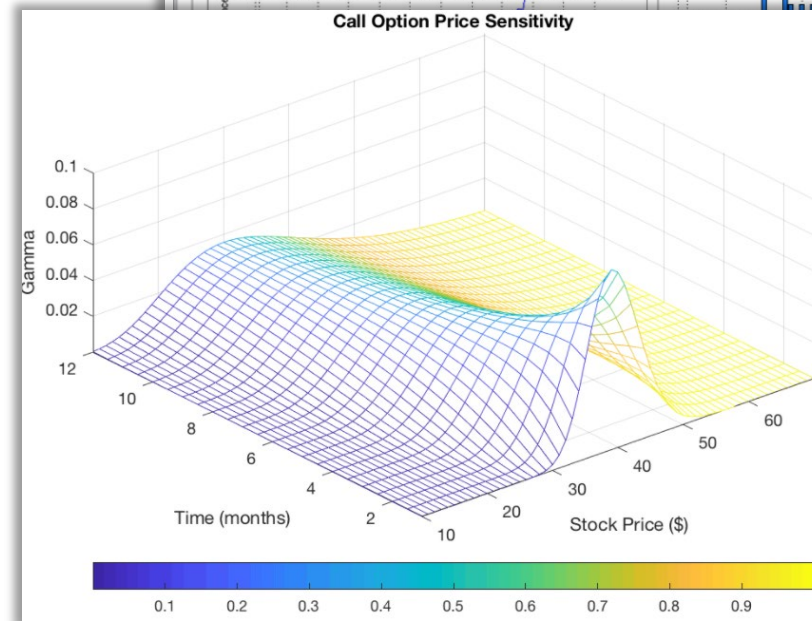
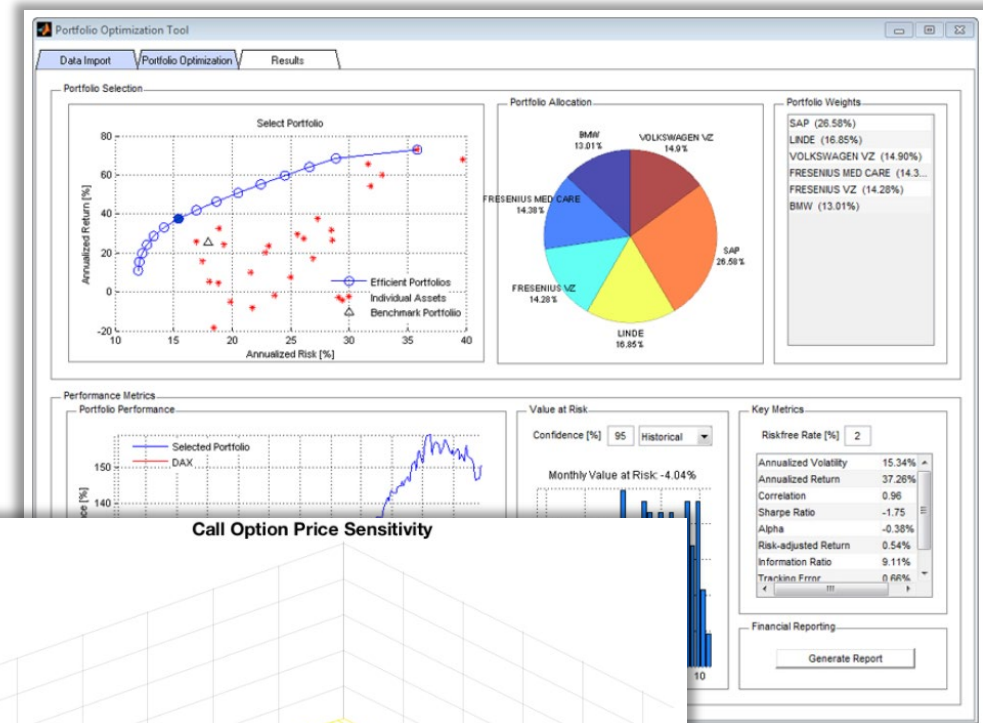
Quantitative Researcher
SEVEN EIGHT CAPITAL
New York, NY

What Is Financial Thinking



Traditional Application Areas of Financial Thinking

- Investment Management
- Risk Management
- Algorithmic Trading
- Financial Forecasting & Modeling
- Derivatives Pricing
- Insurance & Actuarial Science
- ... and many more applications



University of Rome Tor Vergata Graduate Students Acquire Marketable Programming and Asset Pricing Skills

Challenge

Teach graduate students in finance and banking the quantitative analysis and coding skills that are in demand in the industry

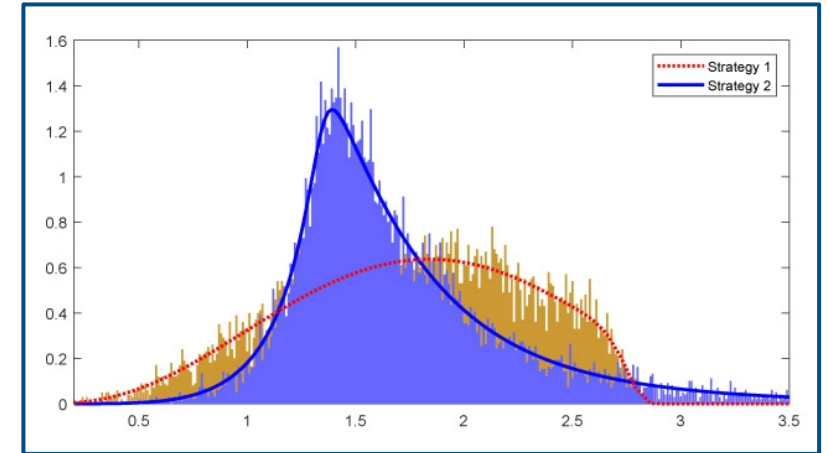
Solution

Take advantage of campus-wide access to MATLAB, online tutorials, and a certification program to enable students to acquire and demonstrate proficiency in MATLAB programming

Results

- Classroom time optimized
- Complex concepts learned through visualization
- Students graduated with in-demand skills

[Link to user story](#)



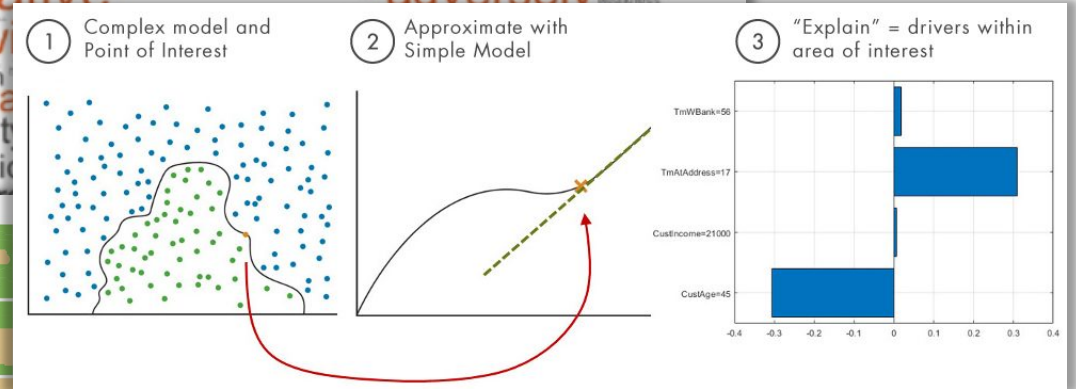
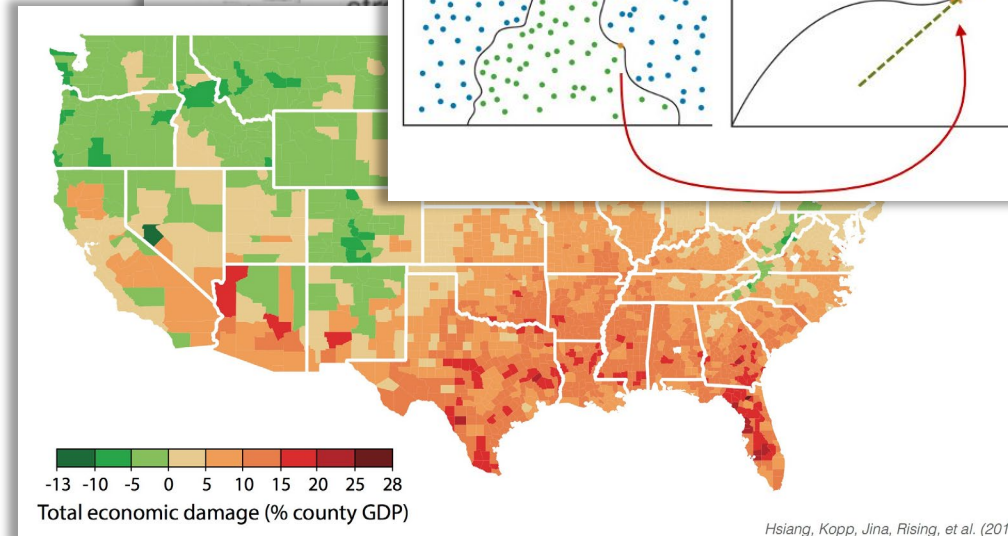
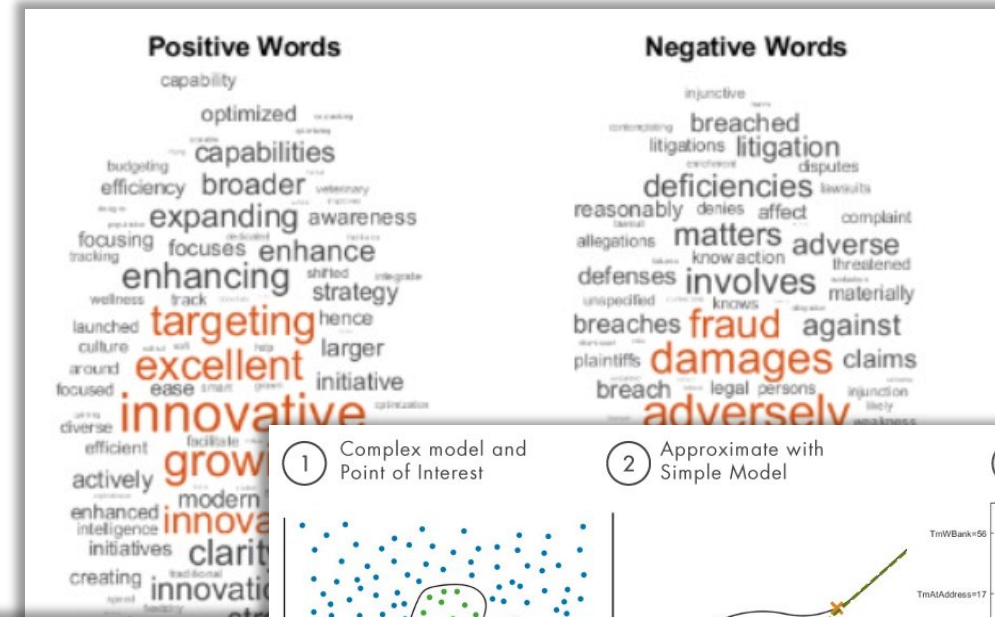
Monte Carlo simulation results for empirical densities returns (bars) and theoretical densities returns (lines) for two dynamic strategies.

“In finance, you only truly understand the theory after you implement it in code and run that code on data to see what it produces—all of which our students do in MATLAB. We know this approach is much appreciated by the industry because our graduates find jobs quite easily.”

- Dr. Stefano Herzel, University of Rome Tor Vergata

Trending/Upcoming Application Areas

- AI is maturing
 - Sentiment Analysis
 - Explainable AI
 - Reinforcement Learning
- Climate Risk
- Quantum Computing



State Street Global Advisors Develops Scoring Model to Bring Transparency to ESG Investing

Challenge

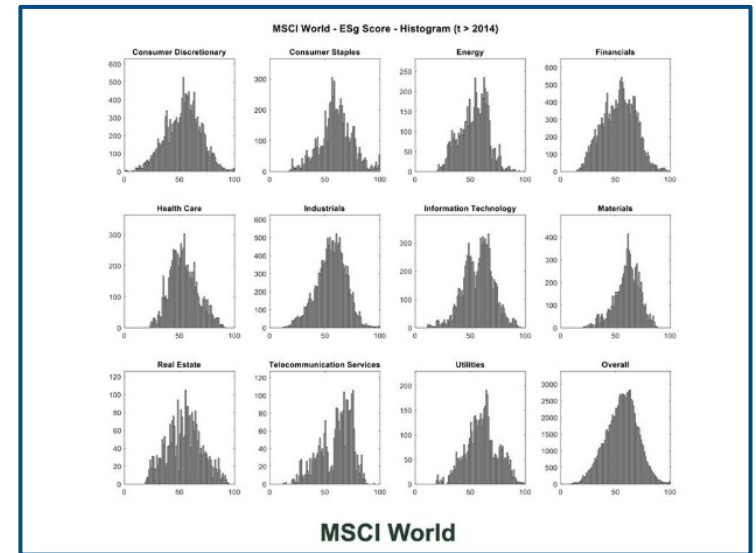
Provide ESG scores to enable institutional investors to make sustainable investing decisions

Solution

Work with MathWorks Consulting Services to accelerate the development of an ESG scoring model that incorporates a transparent materiality framework, national corporate governance codes, and metrics from multiple data providers

Results

- Months of development time saved
- Deadline met despite late framework changes
- Changes implemented in days, not weeks



Histogram showing R-Factor™ ESG scores by industry.

“We were under tremendous time pressure and could not afford to wait around figuring out whether and how R-Factor™ could be built in Python, R, or another language. We needed to move fast, and with MATLAB and support from MathWorks consultants, we were able to deliver.”

- Todd Bridges, Ph.D., State Street Global Advisors

Common Challenges

Industry

- New hires **need to learn multiple technology**/platforms and mathematical concepts to improve collaboration
- Team members need to **use the right tool for the right job** to push the quantitative boundaries
- I want to **upskill my existing staff** rather than recruit experts in specialized domains

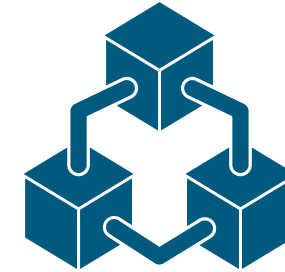
Academia

- I want my students to be **learn multiple programming tools**
- Incoming students **lack sufficient programming experience** / Curriculum needs to focus on concepts
- I want my curriculum material to **prepare students for current industry demands**

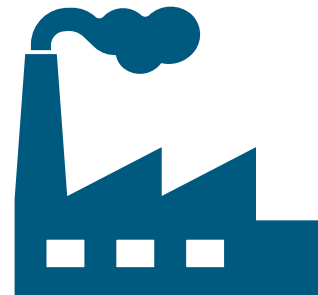
How To Develop Financial Thinking



Self-Learn & Apply



Integration with Technology



Keep up with Industry Trends

Self-Learn and Apply



UI-based Workflows

★ FAVORITES

GPU Coder Hadoop Compiler Database Explorer MATLAB Coder Reinforcement Learning De...

COMPUTATIONAL FINANCE

Binning Explorer Econometric Modeler

DATABASE CONNECTIVITY AND REPORTING

Database Explorer Report Generator

MACHINE LEARNING AND DEEP LEARNING

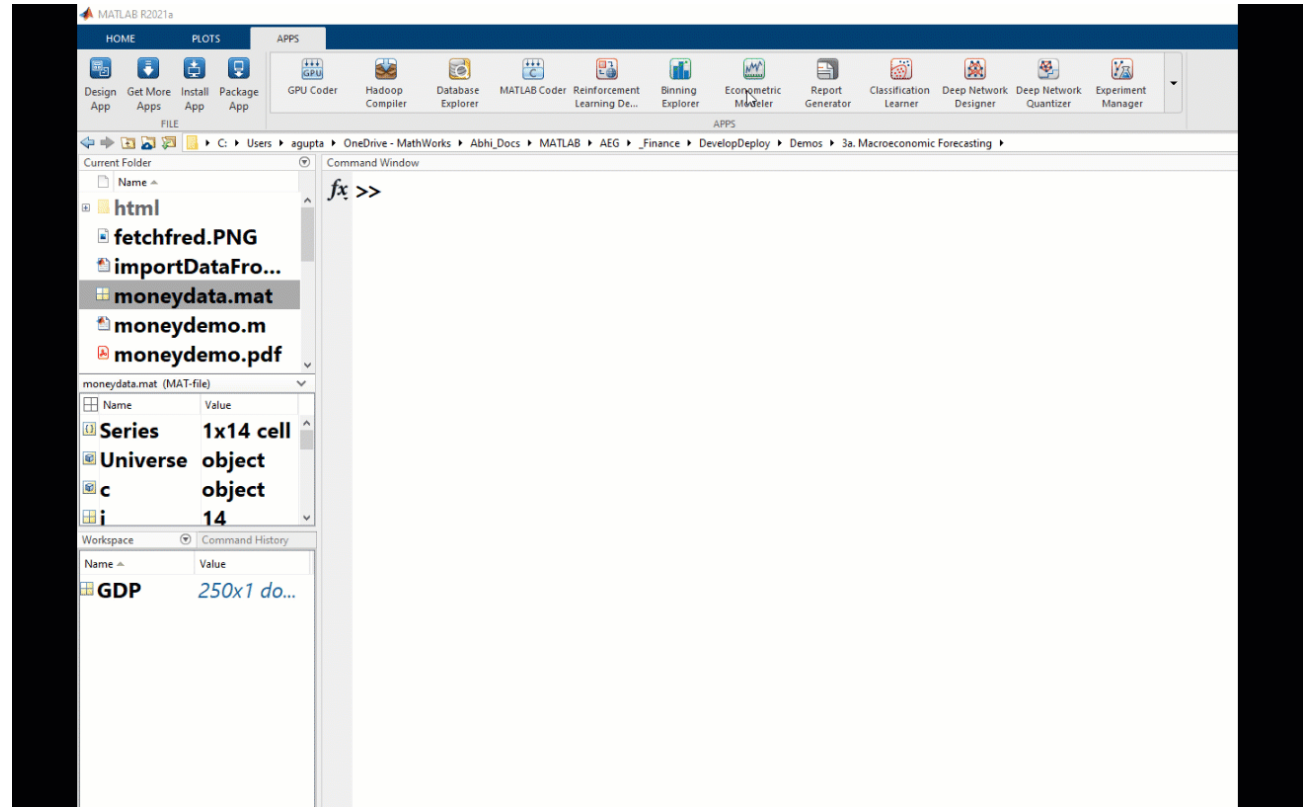
Classification Learner Deep Network Designer Deep Network Quantizer Experiment Manager Neural Net Clustering

MATH, STATISTICS AND OPTIMIZATION

Curve Fitting Distribution Fitter Optimization PDE Modeler

APPLICATION DEPLOYMENT

Application Compiler Hadoop Compiler Library Compiler Production Server Comp... Web App Compiler

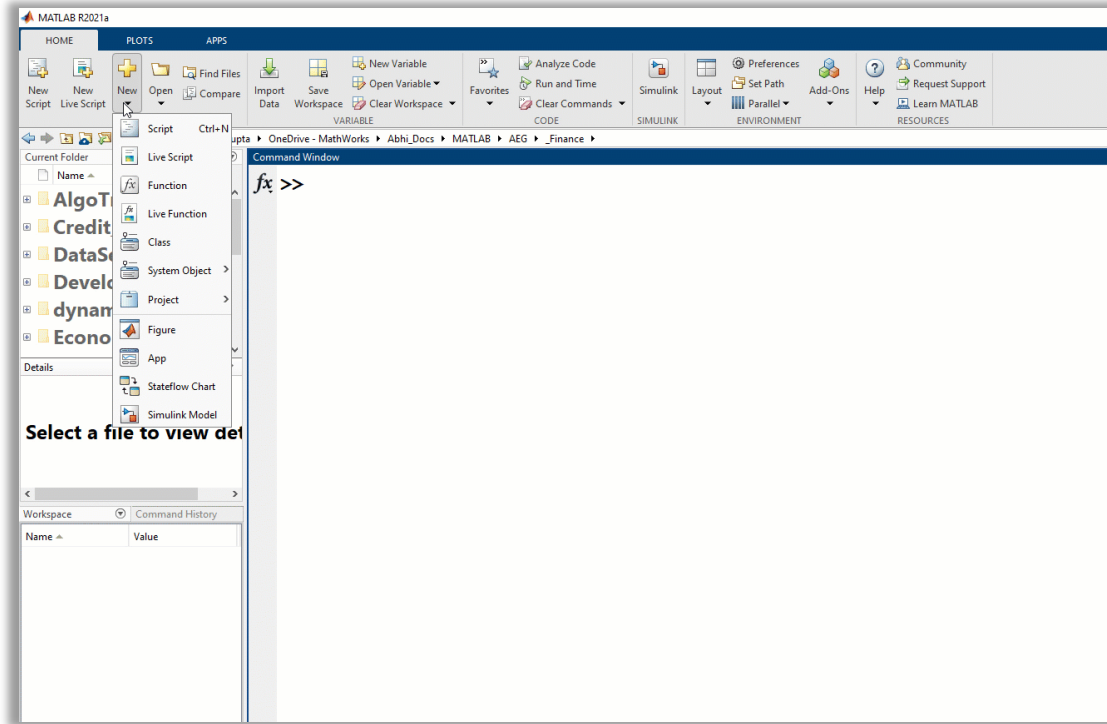


The screenshot shows the MATLAB R2021a interface. The top ribbon includes the 'APPS' tab, which contains various workflow icons. The current folder is 'C:\Users\agupta\OneDrive - MathWorks\Abhi_Docs\MATLAB\AEG_Finance\DevelopDeploy\Demos\3a. Macroeconomic Forecasting'. The Command Window shows the following data table:

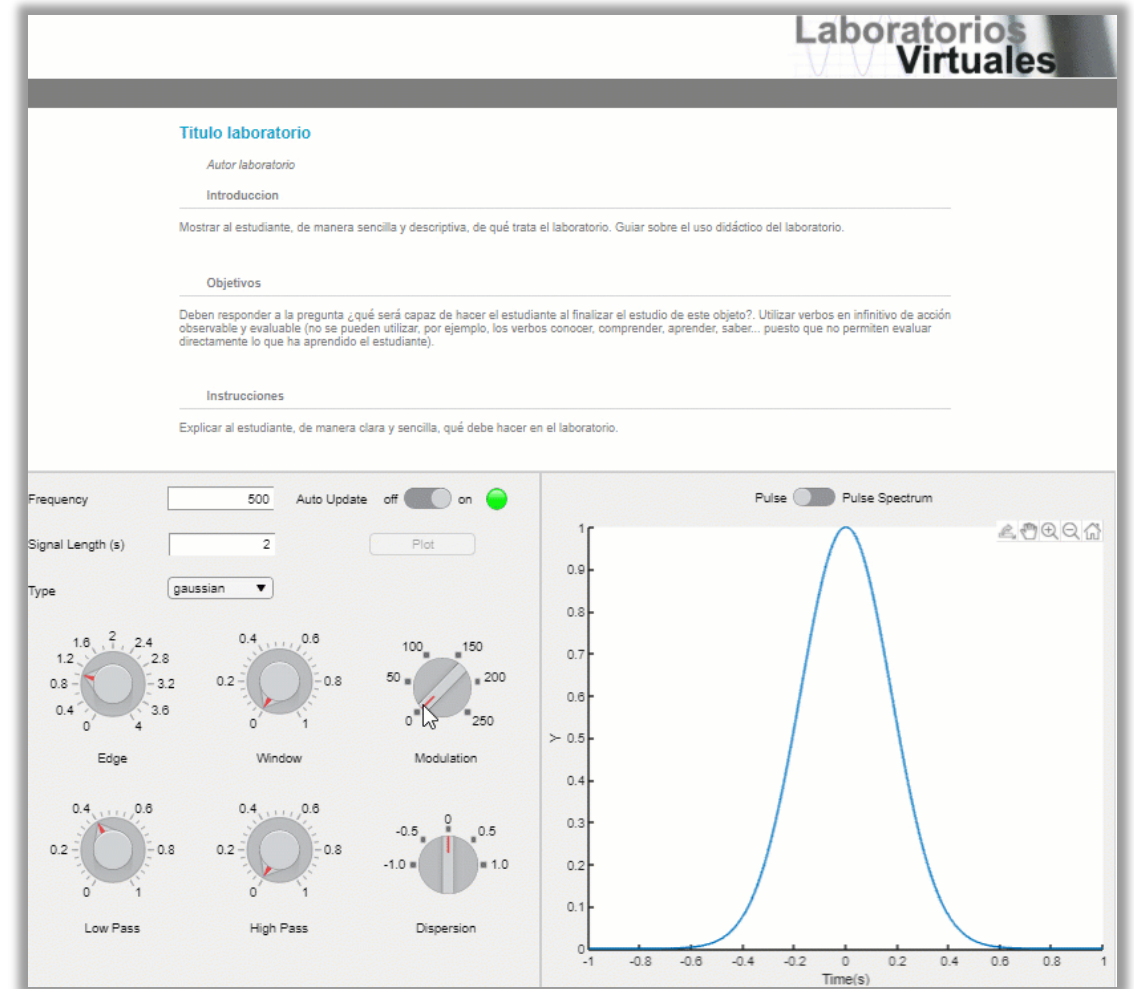
Name	Value
Series	1x14 cell
Universe	object
c	object
i	14
GDP	250x1 do...

[Apps \(In-product\)](#)

UI-based Workflows








[App Designer](#)



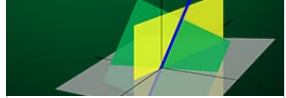
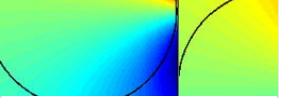
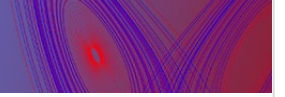


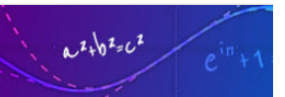
[MATLAB Web App Server](#)

Self-Paced Online Courses


Data Science

 Machine Learning Onramp	 Deep Learning Onramp	 Reinforcement Learning Onramp
 Machine Learning with MATLAB	 Deep Learning with MATLAB	

Computational Mathematics

 Introduction to Linear Algebra with MATLAB	 Solving Nonlinear Equations with MATLAB	 Solving Ordinary Differential Equations with MATLAB
 Introduction to Statistical Methods with MATLAB	 Optimization Onramp	 Introduction to Symbolic Math with MATLAB

Programming

 MATLAB Onramp	 MATLAB Fundamentals	 MATLAB for Data Processing and Visualization	 MATLAB Programming Techniques
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<https://matlabacademy.mathworks.com/>

Quantitative Finance Bootcamp

- Developed and updated based on the request of educators in top Financial Engineering programs
- Curriculum modules for instructor-led or self-guided learning
- Familiarize and refresh key concepts in
 - Programming
 - Statistics & Probability
 - Optimization
 - Linear Algebra
- Programming exercises based on real-world case studies



[Download Bootcamp](#)

Statistics and Probability for Computational Finance

Table of Contents

- Probability Distributions
 - Uniform Distribution
 - Normal Distribution
 - Standard Normal Distribution
 - Log-Normal Distribution
- Case Study: How to model stock prices and returns?
 - Read Data
 - Convert price series to return series
 - Does the stock return series look normal?
 - Does the stock price series look log-normal?
 - Correlation
- Acknowledgement
- Helper Functions

Reorganizing Data

We can see that these two tables have the same format and are from the same date range. Let's join them into one timetable for easier handling. Do this using the [Join Tables Live Task](#). Assign the result to a variable called `indexPrices`.

```
% TODO: Use the Join Tables Live Task to join indexPricesAMER and
% indexPricesEMEA_APAC
```

Variables

n - Number of assets in the portfolio
 m_i - The expected rate of return of the i th asset
 x_i - The optimal percentage of capital to allocate to the i th asset to meet constraints
 C - The $n \times n$ covariance matrix of asset returns
 r - Desired minimum rate of return for the portfolio

Constraints

- The expected rate of return for the Portfolio should be at least the r value described specified by the investor.

$$\sum_{i=1}^n m_i x_i \geq r$$
- The total capital allocation (sum of all x_i) should be 1:

$$\sum_{i=1}^n x_i = 1$$
- All capital allocation should be fractional, therefore between 0 and 1:

$$0 \leq x_i \leq 1, \quad i = 1 \dots n$$

Objective

The classical mean-variance problem consists of minimizing portfolio risk, which is represented as:

$$\frac{1}{2} x^T C x$$

Subject to the above constraints. Since the objective function is quadratic and the constraints are linear, this optimization problem is a quadratic program (QP).

Defining Variables

First, we will import some data to use for our optimization. This includes the fixed variables about our universe of assets, n , m , and C :

```
load portData.mat
```

Next we get the specification of desired minimum return, r , from our investor.

```
r = 0.082;
```

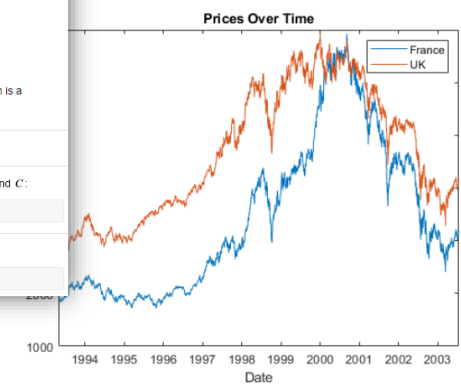
`i = 2665x6 timetable`

Dates	Canada	US	France	Germany	Japan	UK
27-Apr-1993	3.6912e+03	438.0100	1.9274e+03	1.6408e+03	20207	2.8327e+03
28-Apr-1993	3.7102e+03	438.0200	1.9425e+03	1.6289e+03	20455	2.7973e+03
29-Apr-1993	3755	438.8900	1.9206e+03	1.6239e+03	20687	2.7868e+03
30-Apr-1993	3.7894e+03	440.1900	1939	1.6272e+03	20919	2.8131e+03
3-May-1993	3.7734e+03	442.4600	1937	1.6292e+03	2.0845e+04	2.8128e+03
4-May-1993	3.7791e+03	444.0500	1.9236e+03	1.6274e+03	2.0770e+04	2.8126e+03
5-May-1993	3.7888e+03	444.5200	1.9263e+03	1.6232e+03	2.0696e+04	2.7965e+03
6-May-1993	3.7947e+03	443.2600	1.9205e+03	1.6233e+03	20622	2.7863e+03
7-May-1993	3779	442.3100	1.8786e+03	1.6119e+03	20811	2.7937e+03

Data

France and UK data over time. Plot both lines together in a single figure. Give the plot X and Y axis labels, and a title.

Plot the France and UK columns over the dates using the timetable

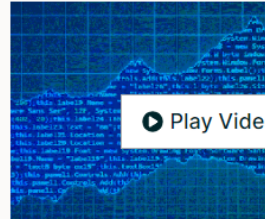



MOOCs





Monetary Policy Analysis and Forecasting

Learn about the macroeconomic motivation of the quarterly projection model (QPM), its key properties, model calibration, data filtration, and how to implement the QPM in MATLAB software in order to learn and understand practical model building and model operation as it is usually done in central banks.



 **Estimated 6 weeks**
8–10 hours per week

 **Self-paced**
Progress at your own speed

 **Free**
Optional upgrade

About the instructors



Mikhail Pranovich

Economist • The International
Monetary Fund

<https://www.edx.org/course/monetary-policy-analysis-and-forecasting>

Browse > Data Science > Data Analysis

Practical Data Science with MATLAB Specialization

★★★★☆ 4.7 749 ratings



Erin Byrne [+11 more instructors](#)

Enroll for Free
Starts Aug 13

Financial aid available

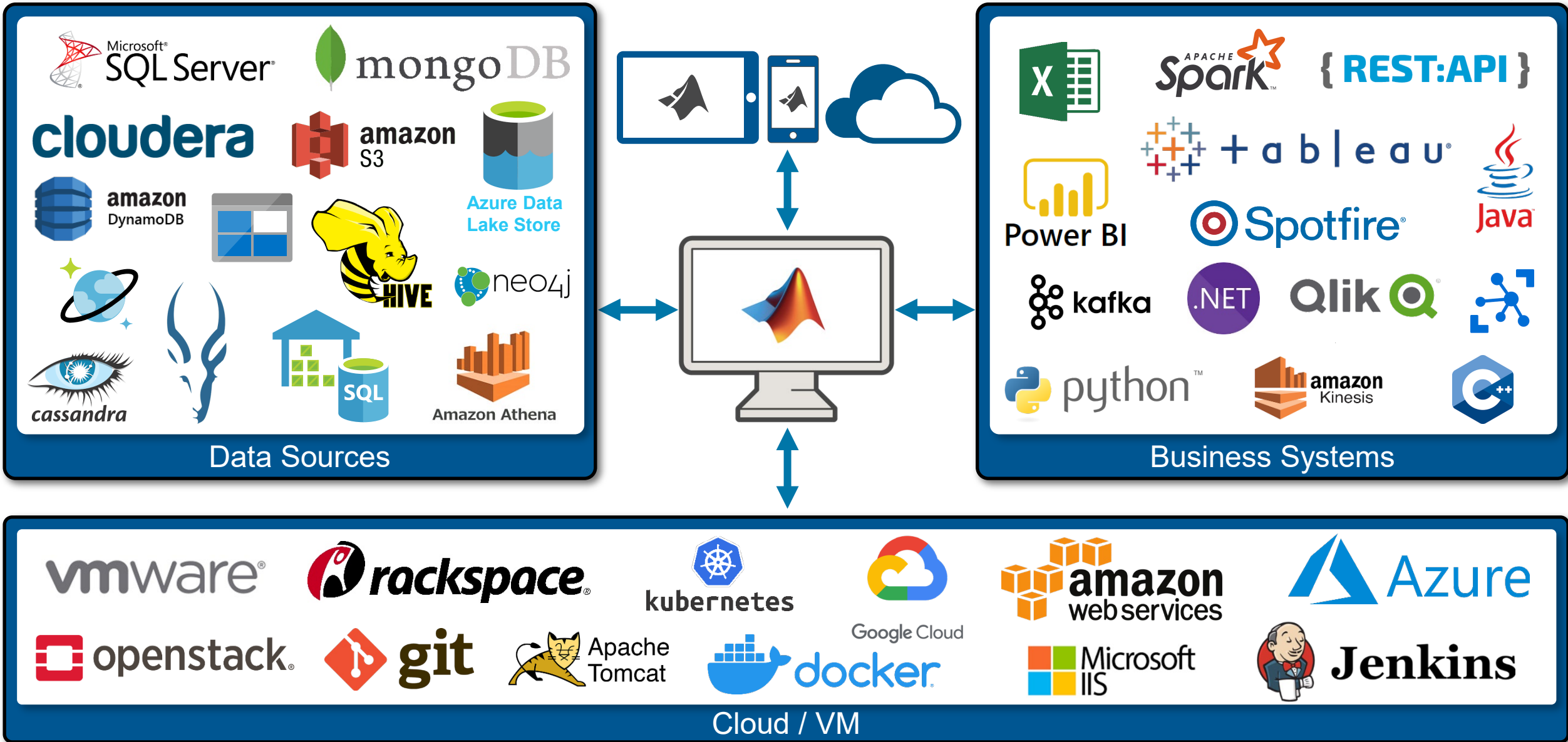
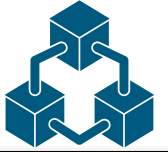
19,322 already enrolled

<https://www.coursera.org/specializations/practical-data-science-matlab>

Integration with Technology

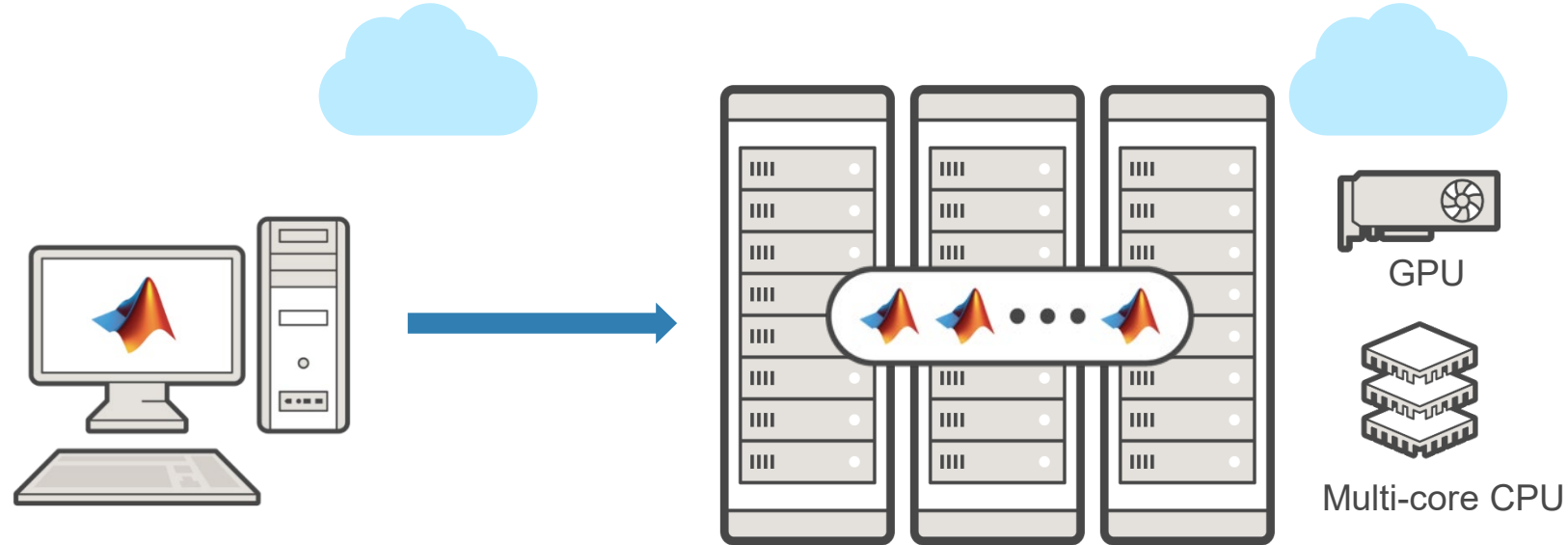


MATLAB and the Analytics Ecosystem





Scale Up Computations



- **More /better hardware**
- **Proximity to cloud data**

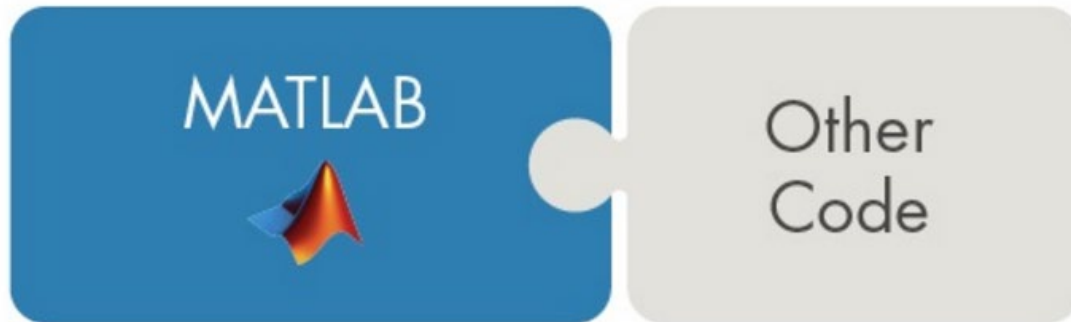
Even more hardware to meet scaling needs

Access requirements	Desktop in the cloud	Cluster in the cloud (Client can be any cloud on on-premise desktop)
Any user could set up	NVIDIA GPU Cloud	MathWorks Cloud Center
Customizable template-based set up	MathWorks Cloud Reference Architecture	
Full set-up in custom environment	Custom installation - DIY	



Interoperability of MATLAB with Other Languages

Calling Libraries Written in Another Language From MATLAB



- Java
- Python
- C
- C++
- Fortran
- COM components and ActiveX® controls
- RESTful, HTTP, and WSDL web services

Calling MATLAB from Another Language



- Java
- Python
- C/C++
- Fortran
- COM Automation server



Aberdeen Asset Management Implements Machine Learning–Based Portfolio Allocation Models in the Cloud

Challenge

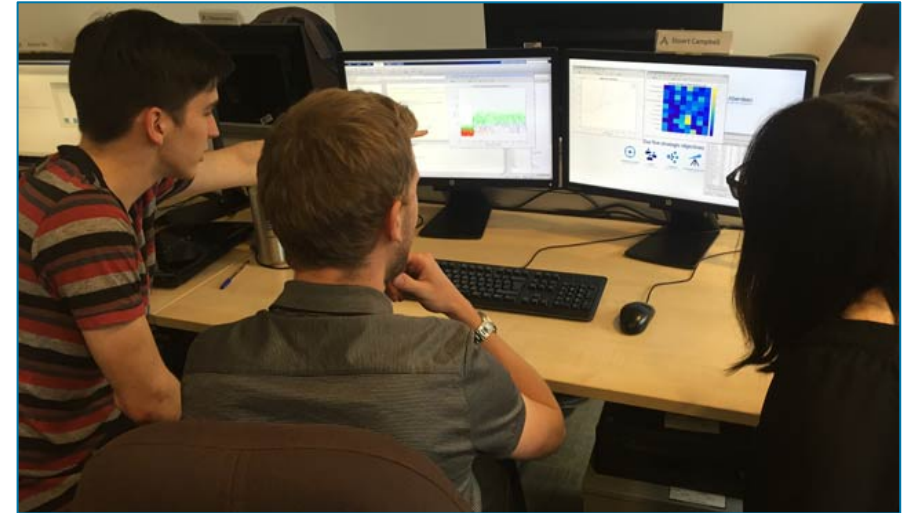
Improve asset allocation strategies by creating model portfolios with machine learning techniques

Solution

Use MATLAB to develop classification tree, neural network, and support vector machine models, and use MATLAB Distributed Computing Server to run the models in the cloud

Results

- Portfolio performance goals supported
- Processing times cut from 24 hours to 3
- Multiple types of data easily accessed

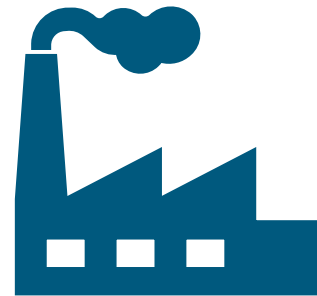


Interns using MATLAB at Aberdeen Asset Management.

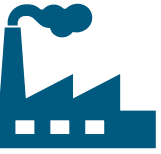
“The widespread use of MATLAB in the finance community is a real advantage. Many university students learn MATLAB and can contribute right away when they join our team during internship programs. In addition, the strong MATLAB libraries developed by academic researchers help us explore all the possibilities of this programming language.”

- Emilio Llorente-Cano, Aberdeen Asset Management

Keep up with Industry Trends



Industry Workflows



Quantitative Finance and Risk Management
Search MathWorks.com


MATLAB for Quantitative Finance and Risk Management

Import data, develop algorithms, debug code, scale up processing power, and more.


FREE WHITE PAPER
Effective Model Risk Management with MATLAB

» Read white paper


Using MATLAB for Finance and Risk Management



Developing and Maintaining Swiss Re's Internal Risk Model ICAM in MATI AR (Highlights)


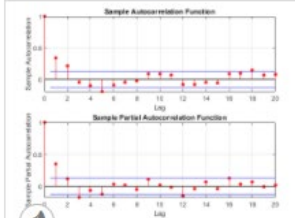
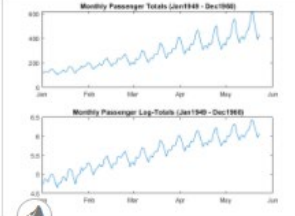
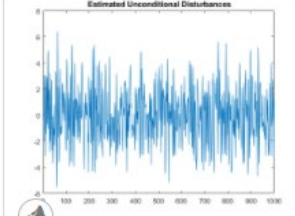


Machine Learning and Big Data in Quantitative Investing

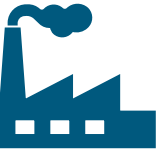


GeisterZähler Develops and Back-Tests Investment Strategies

Autocorrelated and Heteroscedastic Disturbances — Examples

 <p>Specify the Default Regression Model with ARIMA Errors</p> <p>Create a default regression model with ARIMA errors using <code>regARIMA</code>.</p>	 <p>Specify Regression Model with SARIMA Errors</p> <p>Create a regression model with multiplicative seasonal ARIMA errors.</p>	 <p>Estimate a Regression Model with ARIMA Errors</p> <p>Estimate the sensitivity of the US Gross Domestic Product (GDP) to changes in the Consumer Price Index (CPI) using <code>estimate</code>.</p>
 <p>Estimate a Regression Model with Multiplicative ARIMA Errors</p> <p>Fit a regression model with multiplicative ARIMA errors to data using <code>estimate</code>.</p>	 <p>Choose Lags for ARMA Error Model</p> <p>To select the nonseasonal autoregressive and moving average lag polynomial degrees for a regression model with ARMA errors,</p>	 <p>Plot a Confidence Band Using HAC Estimates</p> <p>Plot corrected confidence bands using Newey-West robust standard errors.</p>

Conferences



MATLAB Computational Finance Conference 2018
Search Upcoming Events Upcoming Events [Q](#)

Overview | Agenda | Abstracts | Exhibitors | Demo Stations | Venue | Proceedings

Keynote Presentations

Model Risk Management Principles for
Diederick Potgieter, The Bank of England

Streamlining Financial Modelling: From
David Sampson, MathWorks

MATLAB Computational Finance Conference 2019
Search Upcoming Events Upcoming Events [Q](#)

Overview | Agenda | Abstracts | Exhibitors | Venue | Proceedings | Speak in 2020

Keynote Presentations

Challenge-Response: Data Science and AI in Production
David Rich, MathWorks

Applied Uses of AI for Investment Insights and Operational Efficiency
David Lin, JP Morgan Asset Management

Presentations

The R-Factor: Converting ESG and Corporate Governance Data
Todd Bridges, State Street Global Advisors

CCAR Neural Networks Model
Heng Chen, HSBC and Northwestern University

Applications of Academic Theory and Quant Techniques in Sec
Yasser El Hamoumi, State Street Global Markets
Travis Whitmore, State Street Global Markets

Penn Wharton Budget Model: Macroeconomics in MATLAB
Efraim Berkovich, University of Pennsylvania

MATLAB Computational Finance Conference 2021
Search Upcoming Events Upcoming Events [Q](#)

Overview | Registration

MATLAB Computational Finance Conference 2021

September 27–30 | Online

MATLAB Computational Finance Conference 2021 brings together industry professionals to showcase MATLAB in real-world industry use cases and offer practitioner advice through interactive panel discussions and master classes. Topics include artificial intelligence, sustainable investing, climate risk, portfolio and risk management, and production deployment. You can also explore a new academic track designed for finance educators and students working at the graduate level.

[Register](#)

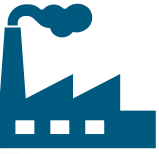
The event is free, but registration is required.

Featured Sessions

Operational Risk Capital Modeling for Extreme Loss Events
Gwen Busby, Greenwood Resources

Optimizing Portfolios for Net Zero with Real Assets

Combining Human and Computer Intelligence in Asset Allocation



Live Events and Videos

MATLAB and Simulink Events

Overview
Live Events
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Conferences
Tradeshows
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Français	3																																								
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Conference	1																																								
Seminar	24																																								
Tradeshow	4																																								
Webinar	53																																								

Videos and Webinars

Videos Home
Search

FILTER BY

Product

MATLAB	159
Simulink	12
Automated Driving Toolbox	1
Bioinformatics Toolbox	1
Computer Vision Toolbox	7
Curve Fitting Toolbox	23
Database Toolbox	14
Datafeed Toolbox	28

Video Type

Conference Talk	41
Demo	63
How To	12
Product Overview	5
User Story	2
Webinar	161

Application

Computational Biology	64
Computational Finance	36
Control Systems	36
Data Analytics	73
Deep Learning	52

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FILTERED BY Computational Finance x Remove All

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Learn about new tools in MATLAB that quants and data scientists can scripts and algorithms, build apps, and leverage team-based software

Date: 28 Jul 2021

MATLAB Integration with Excel

Access the power of MATLAB from Excel with MATLAB calculations t spreadsheets from MATLAB. Automate these and other processes.

Date: 20 Jul 2021

Using MATLAB with Python

MATLAB provides flexible, two-way integration with many programmin webinar will cover how to call MATLAB from Python and how to call P

Date: 15 Jul 2021

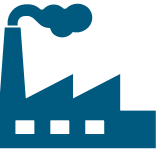
Controlling the COVID-19 Epidemic in Italy Using a Network Model

We show that regional heterogeneity is essential to understanding the Italy as a study case and developing a data-driven approach to design

[Upcoming Events](#)

[On-Demand](#)

25



Example of Live Webinars

Modelling Transition Climate Risk with MATLAB

Event Type	Start Time	End Time
Webex	14 Sep 2021 - 10:00 BST	14 Sep 2021 - 11:00 BST



Overview

The 2015 "Paris Agreement" places a binding obligation on the world's governments to "Make finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development". Financial institutions are being driven by their regulators, customers, investors, and other stakeholders, to do their part towards transitioning to a low carbon economy and managing exposure to climate-related risks.

This raises many new data and modelling challenges. In this session, learn about the tools that MathWorks are making available for: working with data from Integrated Assessment Models (such as the NGFS scenarios), applying climate stress-tests and incorporating temperature alignment goals into investment portfolios.

*Required field

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[Recording](#)

Date	Webinar Topic
Oct 5, 2021	Using MATLAB to Develop & Deploy Financial Models
Oct 13, 2021	Machine Learning and Credit Risk Analysis with MATLAB
Oct 26, 2021	Asset Management with MATLAB
Nov 10, 2021	Sentiment Analysis with MATLAB

[Series Registration Link](#)

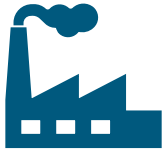
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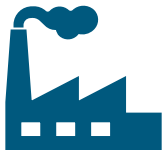
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