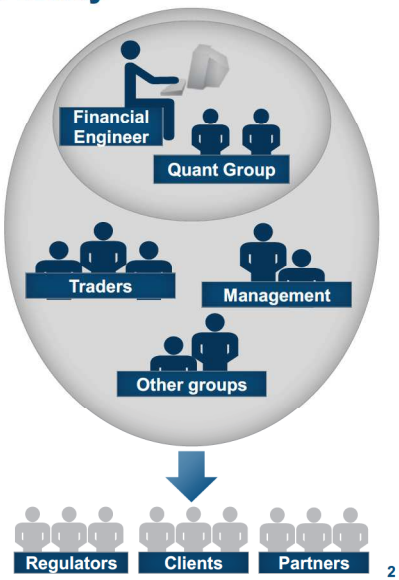
Predictive Modeling with MATLAB

MathWorks Computational Finance Team
Presenter: Francesca Perino

The challenges facing you today

- Volatile markets
  - Ever-changing needs
- More data & Larger models
  - Data Management and Analytics
  - Need for computing power
  - Legacy Reuse and Process Automation



Commerzbank Develops Production Software System for Calculating Derived Market Data

Commerzbank headquarters in Frankfurt.

Challenge
Compute a variety of derived market data from raw market data

Solution
Use MATLAB to read data from a data management system in a Windows and Linux architecture, perform analyses and optimizations, visualize results, and deploy mission-critical calculations

Results
- Integration with existing system simplified
- Implementation time reduced by months
- Updates made in days, not weeks

"Our solution required a Windows client and Linux server software. We used MATLAB to rapidly develop both by taking advantage of distributed computing, a MEX-file interface to access our financial data, and fast, built-in functions for optimization, regression, and more."

Julian Zenglein
Commerzbank

Link to user story

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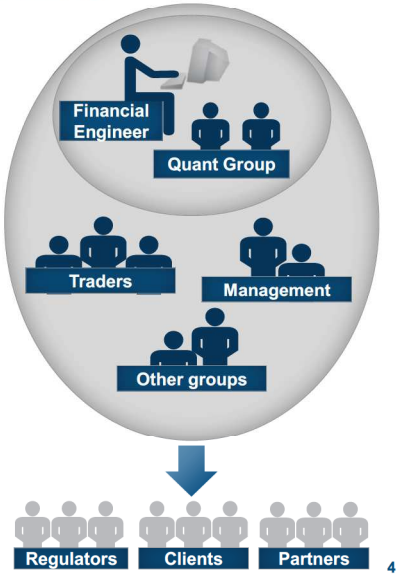
  - Need for computing power
  - Legacy Reuse and Process Automation
- Need for transparency is increasing
  - More auditing and regulation
  - Customer-Centricity



Banca Carige Integrates a MATLAB Based Valuation Library with Its Enterprise Pricing and Risk Platform

Banca Carige corporate headquarters in Genoa.

Challenge
Replace a black-box Microsoft Excel add-in for pricing financial instruments with a more transparent, customizable alternative

Solution
Use MATLAB to develop sophisticated pricing models and deploy them as a .NET component that can be integrated with the bank's structured products platform

Results
- Transparent, flexible pricing model deployed
- Products priced in real time, not weekly
- Integration with existing systems streamlined

"We consider MATLAB to be the best choice for mathematical modeling and numerical computation. MATLAB gives us the unmatched flexibility to embed our algorithms in automated finance systems as add-ins for Excel or components in a .NET framework."

Paolo Raviola
Banca Carige

Link to user story

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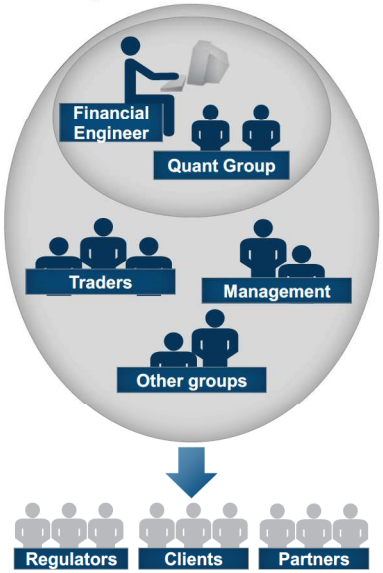
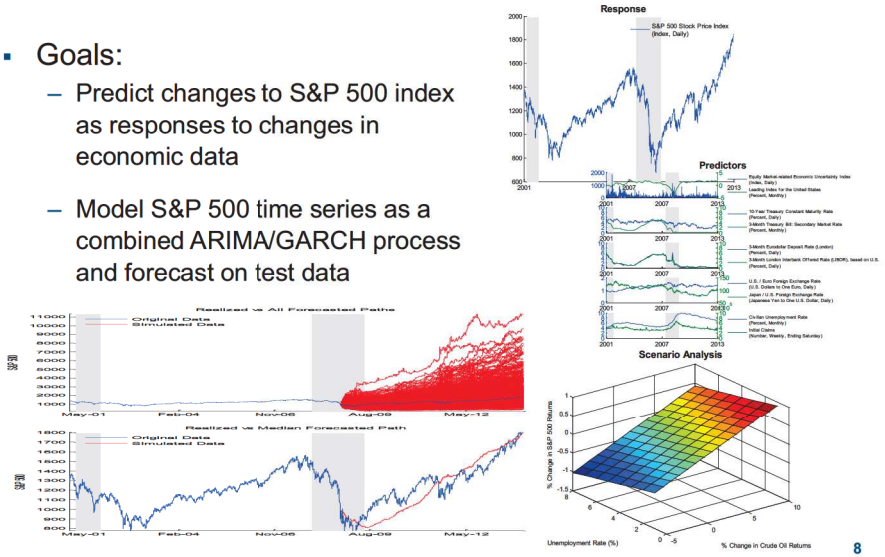


Challenges Faced During Model Development

Traditional Approach	Challenge
Off-the-shelf software	*Inability to customize*
Third-party consulting	***Lack of transparency***
Spreadsheets, Excel	***Robustness, Computational speed, limited data size***
In-house development with traditional languages	***Long development time***
Combination of the above	***Inefficiencies in Integration & Automation***

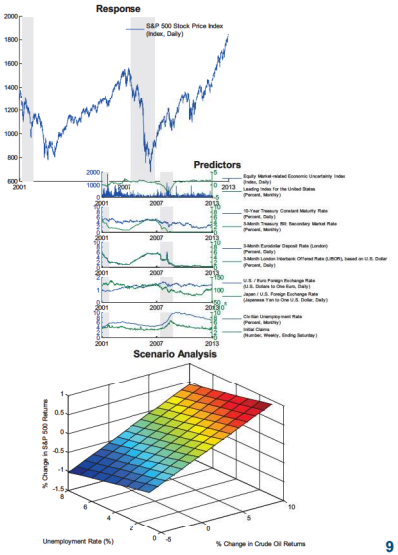
Predictive Modeling Example

- Goals:
  - Predict changes to S&P 500 index as responses to changes in economic data
  - Model S&P 500 time series as a combined ARIMA/GARCH process and forecast on test data

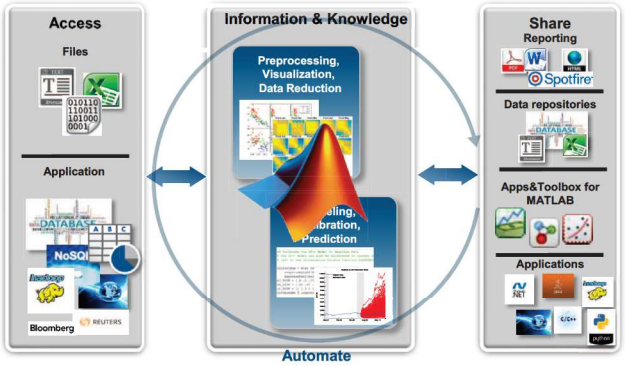


Example – Predicting S&P 500 Responses to Economic Data

- Goal:
  - Predict changes to S&P 500 index as responses to changes in economic data
- Approach:
  - Collect and "clean up" economic and financial market data
  - Model S&P 500 index returns using multiple linear regression, predictor selection and model diagnostic techniques

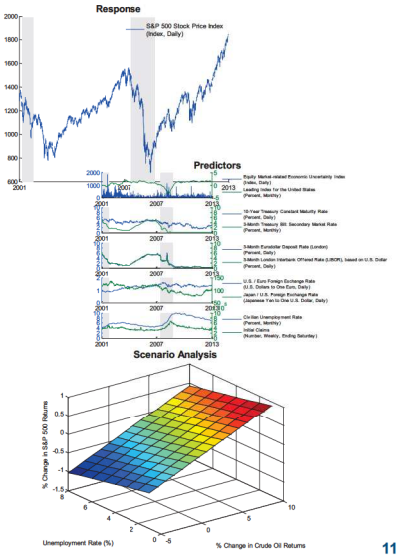


Financial Modeling and Analytics Workflow



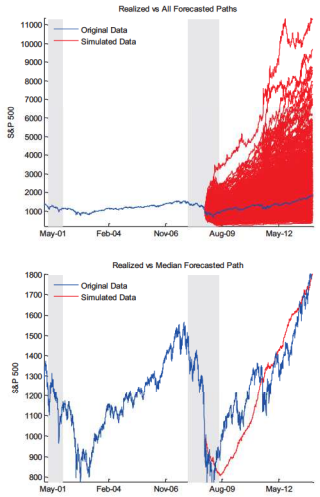
Example – Predicting S&P 500 Responses to Economic Data

- Support for major data providers
- Numerous regression and linear modeling techniques with rich documentation
- Interactive visualizations
- Rapid exploration & development



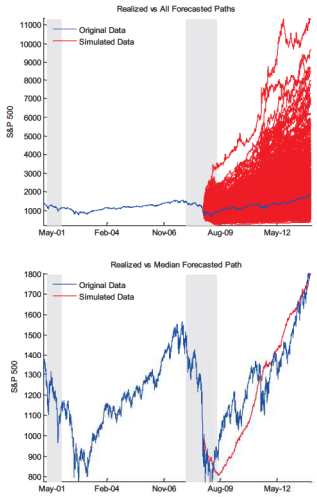
Example – Time Series Modeling and Forecasting for the S&P 500 Index

- Goal:
  - Model S&P 500 time series as a combined ARIMA/GARCH process and forecast on test data
- Approach:
  - Fit ARIMA model with S&P 500 returns and estimate parameters
  - Fit GARCH model for S&P 500 volatility
  - Perform statistical tests for time series attributes e.g. stationarity



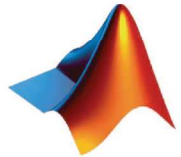
Example – Time Series Modeling and Forecasting for the S&P 500 Index

- Numerous ARIMAX and GARCH modeling techniques with rich documentation
- Interactive visualizations
- Code parallelization to maximize computing resources
- Rapid exploration & development



Predictive Modeling with MATLAB

- Interactive environment
  - Visual tools for exploratory data analysis
  - Easy to evaluate and choose best algorithm
  - Simple code parallelization to maximize resources usage
  - Apps available to help you get started
    (e.g,. neural network tool, curve fitting tool)
- Multiple algorithms to choose from
  - Regression
  - Time series analysis – ARIMAX/GARCH
  - Machine learning techniques



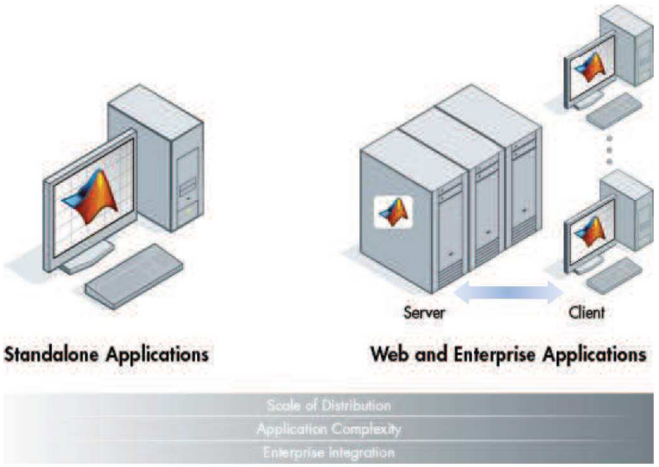
Options for Financial Modeling and Analytics with MATLAB

Challenge	Solution
Inability to customize	**Flexible modeling** ▪ Development and Debugging Environment
Lack of transparency	**White-box modeling** ▪ Viewable-source functions
Subpar computational speed, limited data size	**Powerful computation engine** ▪ Run fast Monte-Carlo simulations
Long development time	**Quick prototyping** ▪ Focus on modeling not programming
Inefficiencies in Integration & Automation	**Easy to Integrate & Deploy** ▪ Point-and-click workflow

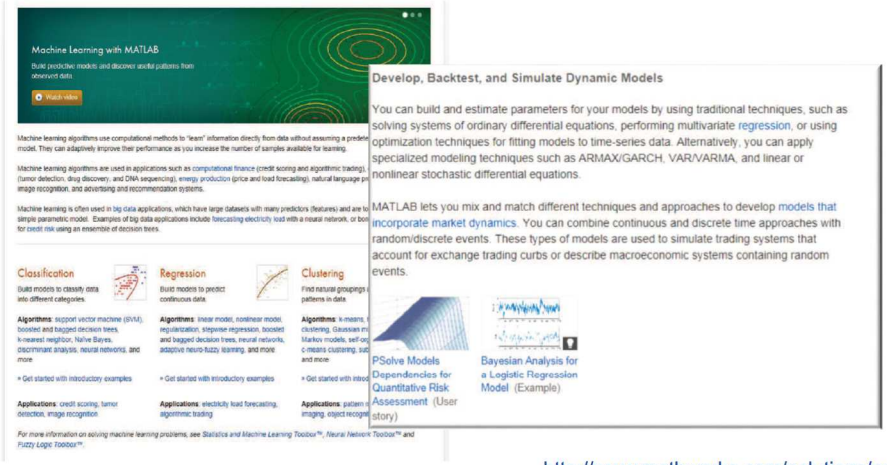
Benefits of Deploying MATLAB Code

- Domain experts maintain ownership of ideas, algorithms, and applications
- Flexibility to integrate with different programming languages
- Implement a common algorithm on different platforms
- Avoid time consuming and error prone re-coding
- Easily adopt algorithm improvements throughout lifecycle

The Range of Application Platforms



To learn more, visit:



www.mathworks.com/machine-learning

http://www.mathworks.com/solutions/computational-finance/time-series-analysis.html

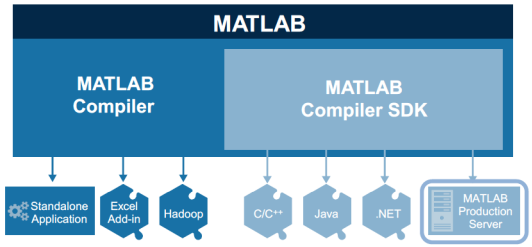
MATLAB Central

- Community for MATLAB and Simulink users
- Over 1 million visits per month
- File Exchange
  - Upload/download access to free files including MATLAB code, Simulink models, and documents
  - Ability to rate files, comment, and ask questions
  - More than 12,500 contributed files, 300 submissions per month, 50,000 downloads per month
- Newsgroup
  - Web forum for technical discussions about MathWorks products
  - More than 300 posts per day
- Blogs
  - Commentary from engineers who design, build, and support MathWorks products
  - Open conversation at blogs.mathworks.com

Based on February 2011 data

Questions?

Which Product will Fit Your Needs?



MATLAB Compiler for sharing MATLAB programs without integration programming

MATLAB Compiler SDK provides implementation and platform flexibility for software developers

MATLAB Production Server provides the most efficient development path for secure and scalable web and enterprise applications