Pandemics, Floods and Manias: *How Smith Finance Prepares Students for Tackling Risks*

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ROBERT H. SMITH SCHOOL OF BUSINESS

Where Applied Research, Outreach, and Education Meet to Solve Financial Services Industry Problems

RESEARCH

OUTREACH

AMERICAN BANKER

THE WALL STREET JOURNAL.

THE HILL

GARP

United States House of Representatives
Committee on Financial Services

SCIENTIFIC AMERICAN

pharma MANUFACTURING

HW

EDUCATION

Risk Management Research Areas

Pharmaceutical Manufacturing (Pandemics)

- Mitigating the risk of drug shortages by leveraging advanced manufacturing technologies
- Increasing domestic pharmaceutical production (lessons learned during the pandemic)
- Impact of manufacturing quality ratings on pharmaceutical market structure

Climate Change (Floods)

- Adapting climate model outputs for physical risk assessments and TCFD disclosures at financial institutions
- Leveraging UMD flood risk models for portfolio analysis
- Development and pricing of climate derivative instruments
- Understanding the linkages between climate and financial/risk models for scenario and stress testing

Financial Crisis (Manias)

- Loan manufacturing quality and credit risk impacts
- Risk-based capital and loan loss reserving
- Credit risk transfer and pricing

TRANSFORMATIONAL LEARNING

Experiential Learning Projects (ELPs) established several years ago provide MS Finance and MS Quantitative Finance students with hands-on projects to "test drive" their academic skills

- A corporate or governmental "sponsor" for each 8-week long ELP
- Typically, "2nd year" students are selected with strong data, modeling, risk management, fixed income and portfolio management coursework
- Projects focused on a real business problem of interest to the sponsor
- Students manage the project in a fast-paced, team-based environment with deliverables to the faculty advisor each week
- ELPs have become regularized for two sponsors which provides them with access to a pool of graduating students with knowledge of their company and business

ELPs Build Critical Technical & Nontechnical Skills

Applied Financial Skills
Leverage core concepts developed in academic coursework for ELP analysis

Data Management
Learn to manage, manipulate and merge very large financial datasets for empirical analysis

IMMEDIATE IMPACT with relevant skill acquisition

Quantitative Methods & Financial Programming
Leverage a wide variety of quantitative tools for analysis: Machine Learning, statistical modeling, Monte Carlo Simulation, Portfolio Optimization
Python, R, SQL, SAS

Intangible Skills Development
Communications
Team-building
Critical Thinking
Project Management
Problem-solving

LEARNER OUTCOMES: An Illustrative ELP on Climate Risk

Incorporate Models Into Analysis	*Inform Decision-making*	*Identify Investment Risks*	*Define Data Requirements*	*Understand Climate Science*
Develop climate data and models into financial and risk analyses and management/mitigation (including stress testing and disclosures) and evaluate the implications and reasonableness of the resulting analysis	Conduct climate risk analysis for investment decision making, strategic planning and effectively communicate key messages	How climate and weather impact company earnings, asset valuations and various enterprise-wide risks (credit, market, operational, supply chain, legal, etc.) and how this might change under current climate trajectories	Explore the types of climate data and models available and evaluate their appropriateness for different combinations of climate variables and risk types	State of the art research, including current and historical trends in global and regional climate change

ELP Projects Have Relevancy to Today's Financial Services Risk Challenges

Greatest Hits

- Valuation of Credit Risk Transfer Securities: Stochastic Simulation Modeling
- Development of a Housing Market Risk Index: A Machine Learning Approach
- Machine Learning vs Parametric Methods for Mortgage Automated Underwriting Scoring Models
- An Empirical Analysis of Expected and Stress Losses on FHA Loans
- Effects of Nonbank Originators and Servicers on Mortgage Default and Prepayment
- Effects of Hurricane Events on Mortgage Loss Severity
- A Copula-based Approach to Determining Mortgage Insurer Counterparty Risk
- Empirical Adjustments to Basel Risk-based Capital Models
- A Stochastic NPV Simulation of Pharmaceutical Manufacturing Investment in the US and Abroad

Strong Corporate and Governmental Support for ELPs

Deloitte.

USAA

CapitalOne

Freddie Mac

Fannie Mae

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FHFA

FHA

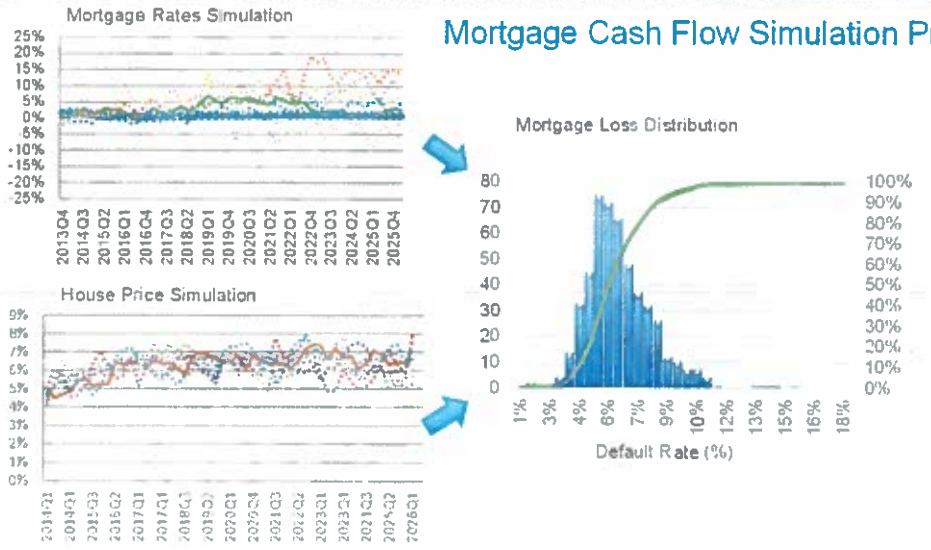
What Do Students Learn in an ELP? A Quick Tour Through Some Recent Projects

Valuation of Credit Risk Transfer Securities: Stochastic Simulation Modeling

In a recent ELP designed to price a government-sponsored enterprise (GSE) Fannie Mae or Freddie Mac credit risk transfer (CRT) security, a group of ELP students in 8 weeks had to do the following:

- Extract a large sample (500,000) of historical mortgage loans from multiple datasets, merge that data with other financial variables (SAS programs)
- Analyze the sample for key relationships, outliers and anomalies (SAS programs)
- Estimate statistical models projecting default and prepayment over a 30-year horizon leveraging survival modeling techniques (SAS programs)
- Estimate stochastic models of mortgage interest rates and house prices for Monte Carlo simulation (R programs)
- Conduct model validations of all estimated models consistent with regulatory guidance for model risk management
- Develop a lognormal mortgage loss distribution using Monte Carlo Simulation (Python programs and 500 paths over 40 quarters)
- Calibrate the credit loss distribution to external ratings (market-based) estimates of expected and unexpected losses
- Use the simulation model to price investor tranches of recent Freddie (STACR) and Fannie (CAS) CRT transactions
- Present model findings to sponsor senior executives

Mortgage Cash Flow Simulation Process



What Do Students Learn in an ELP? A Quick Tour Through Some Recent Projects

Machine Learning (ML) vs Parametric Methods for Mortgage Automated Underwriting Scoring Models

- Extract a large sample of historical mortgage loans from multiple datasets, merge that data with other financial variables (SAS programs); create a development and validation sample
- Analyze the sample for key relationships, outliers and anomalies (SAS and Python programs)
- Estimate statistical models projecting leveraging logistic regression modeling techniques (SAS and Python programs) to predict the likelihood of a late-stage mortgage delinquency (90+ days past due)
- Develop a set of machine learning models trained on the same data as the statistical model (SAS and Python programs)
  - Random Forest
  - Extreme Gradient Boosting Methods (XGBoost)
  - Neural Networks
- Develop model risk performance metrics and test the models on the validation sample (SAS and Python programs)
- Conduct champion-challenger analysis on the ML and logistic regression models
- Present model findings to sponsor senior executives

What Do Students Learn in an ELP? A Quick Tour Through Some Recent Projects

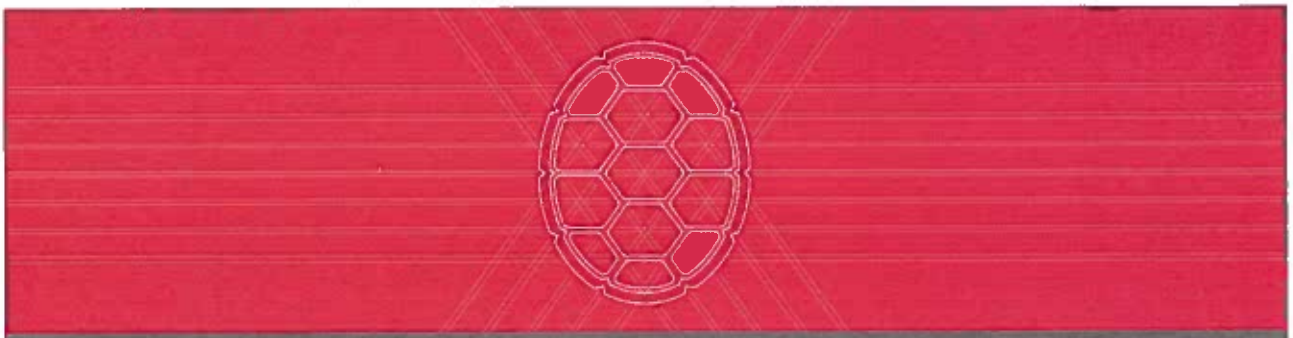
Determining the Impact of Hurricanes on Mortgage Default and Prepayment

- Extract a large sample of historical mortgage loans from multiple datasets, merge that data with other financial variables (SAS programs) and FEMA disaster declaration data and NOAA historical hurricane data: create a development and validation sample
- Develop default and prepayment models leveraging logistic and survival regression techniques augmented with variables defining the average number of hurricanes experienced and average hurricane rating (Saffir-Simpson Hurricane Wind Scale) at the local level (SAS and Python programs)
- Leverage machine learning models to guide the statistical model specification
- Develop model risk performance metrics and test the models on the validation sample
- Present model findings to sponsor senior executives

Other Finance Department Risk Management Touchpoints

- UMD Climate Change Finance & Risk Management Interdisciplinary Initiative Bringing UMd Climate Science and Finance & Risk Management Faculty Together
- Center for Financial Policy Federal Risk Academy Executive Education Program in Collaboration with Deloitte
- Center for Financial Policy Mortgage Bankers Association Advanced Risk Management Training Program
- Center for Financial Policy Mortgage CRO Risk Summit
- Center for Financial Policy Risk Leadership Webinar Series
- FDA Office of Pharmaceutical Quality Research Grants

Where Do Our Risk Management Students Land?



QUESTIONS?

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