Financial Engineering

The objective of the M.S. in Financial Engineering program is to provide students with a strong education in advanced finance, risk management, and quantitative financial analysis tools, grounded in a common series of courses. This sequence will provide key concepts from financial theory, applied mathematics, and engineering. With these building blocks, program graduates will become instrumental in the creation of innovative solutions for real financial problems, using state-of-the-art analytical techniques and computing technology.

This program equips students with the necessary skill set to prepare for the Financial Risk Manager® examination offered by The Global Association of Risk Professionals (GARP). (http://www.garp.org/)

PREREQUISITES
Applicants must show basic competency in the following areas: investments, probability and statistics, and calculus. These courses will not count toward the master’s degree. Examples are given from Lehigh courses; prerequisites do not need to be taken at Lehigh.

Investments-REQUIRED
FIN 323 Investments (OR) 3
GBUS 420 Investments (OR) 3
Equivalent course

Statistics and Probability-REQUIRED
MATH 231 Probability and Statistics (OR) 3
ISE 328 Engineering Statistics (OR) 3
Equivalent introductory calculus-based statistics and probability course

Calculus Series-REQUIRED
MATH 021 Calculus I (AND) 0,4
MATH 022 Calculus II (OR) 4
Equivalent calculus series

Financial Accounting-HIGHLY RECOMMENDED
ACCT 108 Fundamentals of Accounting (OR) 3
ACCT 151 Introduction to Financial Accounting (OR) 3
GBUS 401 Financial Reporting for Managers and Investors (OR) 3
Equivalent accounting course

Corporate Finance-HIGHLY RECOMMENDED
FIN 328 Corporate Financial Policy (OR) 3
GBUS 419 Financial Management (OR) 3
Equivalent course

Linear Algebra-HIGHLY RECOMMENDED
MATH 205 Linear Methods (OR) 3
MATH 242 Linear Algebra (OR) 3-4
Equivalent course

Calculus - HIGHLY RECOMMENDED
MATH 023 Calculus III (OR) 4
Equivalent Course

To those admitted without business coursework: Instructors teaching in the MFE Program’s Coursework assume that all prospective students have met the prerequisite business foundation requirements. Although we only require an Investments course, we assume that the student has a background in financial accounting, introductory finance, corporate finance, and investments. Please note you will be competing against students within the classroom that have all these business foundation courses. You are encouraged to gain the necessary background by either taking these courses prior to coming to Lehigh or taking these foundation courses during your first term.

To those admitted without the quantitative coursework: Instructors teaching in the MFE Program’s Coursework assume that all prospective students have met the prerequisite mathematics foundation requirements. Although we only require a 2-course Calculus series and a math-based Probability/Statistics course, we recommend an Advanced Calculus course, as well as a course in Linear Algebra. Please note you will be competing against students within the classroom that have all these additional foundation courses.

You are encouraged to gain the necessary background by either taking these courses prior to coming to Lehigh or taking these foundation courses during your first term.

Required Courses

CORE: 6 courses (18 credits)
MATH 467 Stochastic Calculus 3
MATH 312 Statistical Computing and Applications (OR) 3,4
STAT 410 Random Processes and Applications 3
GBUS 421 Advanced Investments (Fixed Income) 3
GBUS 422 Derivatives and Risk Management 3
ISE 426 Optimization Models and Applications 3
ISE 447 Financial Optimization 3

ELECTIVES: Choose 3 courses (9 credits) from one of the following 3 tracks
Quantitative Risk Track
MATH 468 Financial Stochastic Analysis 3
STAT 439 Time Series and Forecasting 3
GBUS 424 Advanced Topics in Financial Management (Risk Management) 3

Data Science & Financial Analytics Track
ISE 465 Applied Data Mining 3
ISE 467 3
ISE 444 Optimization Methods in Machine Learning 3
STAT 438 Linear Models In Statistics with Applications 3
CSB 442 Blockchain: Mathematical Foundations and Financial Applications 3

Financial Operations Track
GBUS 426 Financial Markets and Institutions 3
GBUS 421 Advanced Investments (Security Analysis) 3
GBUS 424 Advanced Topics in Financial Management (Valuation) 3
ISE 413 3

Machine Learning Requirement: Choose 1 course (3 credits)
CSE 326 Fundamentals of Machine Learning (OR) 3
CSE 426 Fundamentals of Machine Learning 3
ISE 364 Introduction to Machine Learning 3
STAT 465 Statistical Machine Learning 3

Capstone: 2 courses (4 credits)
GBUS 485 Financial Engineering Practicum Capstone I 2
GBUS 487 Financial Engineering Practicum Capstone II 2

Developmental: 2 course sequence (2 credits)
GBUS 482 FINANCIAL I 2
GBUS 483 FINANCIAL ENGINEERING PROFESSIONAL DEVELOPMENT II 1

TOTAL CREDITS REQUIRED FOR DEGREE 36

FINANCIAL ENGINEERING CERTIFICATE PROGRAMS
The M.S. in Financial Engineering Program offers three certificate programs to candidates in the MFE program. Certificates are available in Data Science & Financial Analytics, Quantitative Risk Management, or Financial Operations Research and may be earned by completing an additional two courses for a total of 36 credit hours. Candidates for the MFE degree do not need to apply initially for certificate programs.
Students meet with any Program Director to select their certificate choice (if any) once they are enrolled in the program.

Certificate programs enhance skills and development by allowing additional exploration in three main functional areas.

1. **Data Science & Financial Analytics (DSFA) Certificate**
   The objective is to provide students with a unique skill set preparing them for careers in the interdisciplinary field of Data Science and Financial Analytics, with particular application to the financial services industry. Skills developed include working with massive data sets, data-driven analytical methodologies, SAS and R programming, Data Mining, and Machine Learning.

   **Curriculum: 12 Credits**
   ISE 465  **Applied Data Mining (REQUIRED) 3**
   One of the two courses below:  
   ISE 467  ** Optimization Methods in Machine Learning (OR) 3**
   ISE 444  **Optimization Methods in Machine Learning**
   AND
   MATH 312  **Statistical Computing and Applications (REQUIRED) 3**
   One of two data-intensive finance courses below:  
   GBUS 422  **Derivatives and Risk Management (OR) 3**
   OR
   GBUS 424  **Advanced Topics in Financial Management ( Risk Management) 3**

2. **Quantitative Risk Management (QRM) Certificate**
   The objective is to train students in the quantitative methodologies and regulatory practices that are essential for risk management functions within a financial institution. Prepares students for and reinforces material from the FRM examination. The Financial Risk Manager (FRM) designation is the premier certification for professionals in financial risk management. The two-part exam contains the following topics, many of which overlap the curriculum of the MSFE program: Financial Markets and Products, Valuation and Risk Models, Quantitative Analysis, Foundations of Risk Management, Market Risk, Credit Risk, Operational Risk, Risk Management and Investment Management, and Current Regulatory Issues. Furthermore, Lehigh’s MSFE program is an Academic Partner of the Global Association of Risk Professionals (GARP) who administers the FRM certification.

   **Curriculum: 12 credits**
   GBUS 422  **Derivatives and Risk Management 3**
   GBUS 424  **Advanced Topics in Financial Management (Risk Management) 3**
   GBUS 426  **Financial Markets and Institutions 3**
   ONE of the following MATH/STAT courses:
   STAT 434/MATH 334  **Mathematical Statistics 3**
   MATH/STAT 461  **Topics In Mathematical Statistcs 3**
   STAT 438/MATH 338  **Linear Models In Statistics with Applications 3**

3. **Financial Operations Research**
   The objective is to provide the student with an understanding of the fundamental techniques underlying Operations Research Techniques that are of ubiquitous use in all areas of business today like Linear Programming, Game Theory, Dynamic Programming, Integer Programming, Nonlinear Programming, and Machine Learning.

   **Curriculum: 12 Credits**
   ISE 426  **Optimization Models and Applications (REQUIRED) 3**
   ISE 447  **Financial Optimization (REQUIRED) 3**
   Two (2) electives from the following courses:
   ISE 458  **Topics in Game Theory ( OR) 3**
   ECO 463  **Topics in Game Theory 3**
   ISE 455  **Optimization Algorithms and Software 3**

**ADMISSIONS**
Applications are accepted through the graduate online application system at https://www.applyweb.com/lehighg/index.ftl. International students must have 16 years of schooling with four years at the university level to be considered for admission. Applicants whose native language is not English are required to take either the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS) exam.

Further information about the M.S. in Financial Engineering Program may be obtained by visiting the MFE website (https://business.lehigh.edu/academics/graduate/masters-programs/ms-financial-engineering/), contacting the Graduate Programs Office of the College of Business (https://business.lehigh.edu/graduate/contact/) or one of the following Co-Directors:
- **Dr. Richard Kish**, Perella Department of Finance, College of Business
  - Lehigh University, 621 Taylor Street, Bethlehem, PA 18015
  - Phone (610) 758-4205 / Email rjk7@lehigh.edu
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