Analytical Finance

The Master of Science in Analytical Finance (MSAF) program provides students with a strong education in advanced finance and quantitative financial analysis tools to develop graduates who can create innovative solutions for real financial problems, using state of the art analytical techniques and computing technology. Students with undergraduate degrees in computer science, economics, engineering, finance, mathematics and the hard sciences should have the quantitative background needed for success in this field.

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: corporate finance, investments, financial accounting, statistics, linear algebra, and calculus. These courses will not count toward the master degree.

Entrance Prerequisites
(Examples given from Lehigh courses)
Must show basic competency in the following areas: (Does not count towards the 30 credit minimum degree requirement)

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

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

Financial Accounting
ACCT 151  Introduction to Financial Accounting (OR)  3
ACCT 108  Fundamentals of Accounting (OR)  3
GBUS 401  Financial Reporting for Managers and Investors  3

Equivalent accounting course

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

Calculus Series
MATH 021  Calculus I (AND)  4
MATH 022  Calculus II (AND)  4
MATH 023  Calculus III  4

Equivalent calculus series

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

Note: Accepted applicants at Lehigh typically have several prerequisites that must be fulfilled.

Note: Prerequisites do not have to be taken at Lehigh University.

Note: ECO 045 or an equivalent introductory statistics course including simple regression analysis is not rigorous enough preparation for MATH 467 and therefore is not adequate for the Statistics and Probability prerequisite.

Required Courses
The 30 credit hour program is a joint venture of the College of Business and Economics, the P.C. Rossin College of Engineering and Applied Science and the College of Arts & Sciences. Required courses are as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MATH 467</td>
<td>Financial Calculus I (fall)</td>
<td>3</td>
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<tr>
<td>MATH 468</td>
<td>Financial Calculus II (spring)</td>
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<tr>
<td>Select one of the following Statistics courses:</td>
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<td>STAT 410</td>
<td>Random Processes and Applications (fall)</td>
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<tr>
<td>STAT 412</td>
<td>Statistical Computing and Applications</td>
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<td>Select one of the following computation modeling courses:</td>
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<td>ECO 415</td>
<td>Econometrics I (fall)</td>
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<tr>
<td>STAT 408</td>
<td>Linear Models In Statistics with Applications (spring)</td>
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<tr>
<td>Select one of the following Industrial Engineering courses:</td>
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<td>ISE 426</td>
<td>Optimization Models and Applications</td>
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<td>ISE 429</td>
<td>Stochastic Models and Applications</td>
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Finance Core
GBUS 421  Advanced Investments (Fixed Income - spring)  3
GBUS 422  Derivatives and Risk Management (fall)  3
GBUS 424  Advanced Topics in Financial Management (Risk Management - spring)  3

Computing Core
ISE 447  Financial Optimization  3

Capstone Practicum
ISE 441  Financial Engineering Projects  3

Total Credits  30

Note: Students with equivalent courses from an undergraduate degree program will be given credit for fulfilling the field requirement and will be permitted to replace the credits from the list of approved electives. The program director(s) must approve courses for each student’s choice of electives. Typically, a finance elective will be used to substitute for a finance course waiver; a computational elective to substitute for a statistics/econometric course, and programming elective for a computing course.

ANALYTICAL FINANCE CERTIFICATE PROGRAMS
The M.S. in Analytical Finance Program offers three certificate programs to candidates in the MSAF 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 MSAF 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.

For the three (3) proposed Certificate Programs, the description for the Catalog of the Certificate Programs are the following:

The objective is to provide students with a unique skillset 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 (3 Credits)
- One of the two courses below:
  - ISE 469 Mining of Large-scale Datasets (3 Credits)

2. Quantitative Risk Management (QRM) Certificate
The objective is to provide students with a unique skillset preparing them for careers in the field of quantitative risk management, 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 (3 Credits)
- One of the two courses below:
  - ISE 469 Mining of Large-scale Datasets (3 Credits)

The objective is to provide students with a unique skillset preparing them for careers in the field of financial operations research, 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 (3 Credits)
- One of the two courses below:
  - ISE 469 Mining of Large-scale Datasets (3 Credits)
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 MSAF 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 MSAF 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 Credits)
- GBUS 424 Adv Topics in Financial Management – Risk Management (3 Credits)
- GBUS 426 Financial Markets and Institutions (3 Credits)
- One of the following MATH/STAT courses:
  - STAT 434 / MATH 334 Mathematical Statistics (3,4 Credits)
  - MATH 461 (STAT 461) Topics In Mathematical Statistics (3 Credits)
  - STAT 438/MATH 338 Linear Models in Statistics w/ Applications (3,4 Credits)

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 (3 Credits)
- ISE 447. Financial Optimization (3 Credits)
- Two (2) electives from the following courses:
  - ISE 458. (ECO 463) Game Theory (3 Credits)
  - ISE 455. Optimization Algorithms and Software (3 Credits)
  - ISE 407. Computational Methods in Optimization (3 Credits)
  - ISE 416. Dynamic Programming (3 Credits)
  - ISE 444. Optimization Methods in Machine Learning (3 Credits)
  - ISE 467 Mining of Large-scale Datasets (3 Credits)

ADMISSIONS

Applications are accepted through the graduate online application system at https://www.applyweb.com/lehighg/index.ftl. Applicants must take either the GRE or GMAT. 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. Deadline for international applicants to apply is February 15. U.S. Citizens may apply until July 15.

Further information about the M.S. in Analytical Finance Program may be obtained by visiting http://cbe.lehigh.edu/msaf, contacting the Graduate Programs Office of the College of Business and Economics or one of the following Co-Directors:

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Dr. Luis Zuluaga, Department of Industrial and Systems Engineering, Lehigh University, 200 W. Packer Avenue, Bethlehem, PA 18015, phone (610) 758-5182, email: luis.zuluaga@lehigh.edu