ENGINEERING
MANAGEMENT
GRADUATE
STUDENT
HANDBOOK

Master of Engineering Program

Cornell Engineering
Engineering Management

2018-2019
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SECTION 1 - INTRODUCTION

Welcome to Cornell University and, in particular, to the College of Engineering, and the Engineering Management Program. We hope your year here will be both an academically rich and personally rewarding experience. This handbook has been prepared to simplify the orientation and registration process of new candidates for the Master of Engineering degree in Engineering Management, and help them develop their academic program. Additional information can be obtained from the graduate program office in 219 Hollister.

1.1 The Engineering Management Program

The Engineering Management program has a strong educational tradition. Since its inception in 1988, the program has attracted students with bachelor’s degrees in all of the various engineering fields. Mechanical, biomedical, civil, electrical, computer science, industrial/operations research, chemical, applied and engineering physics, and environmental engineering students have all participated in the program. We have more than 800 alumni who hold important positions in engineering, product management, finance, consulting, research and development, manufacturing, sales, education, construction management, and government in the U.S. and around the world.

The Engineering Management program is housed in Hollister Hall, which is also home to the School of Civil & Environmental Engineering. Appendix A lists the Engineering Management program faculty and their particular specializations.

The three key individuals responsible who manage the Engineering Management program are

Director, Master of Engineering Program in Engineering Management: Patrick Reed, 211 Hollister, pmr82@cornell.edu

Executive Director, Engineering Management Program: Andrea Ippolito, 205 Hollister Ave, 339-234-0164, aki2@cornell.edu

Graduate Field Assistant (GFA): Tania Sharpsteen, 219 Hollister, 255-7560, tms235@cornell.edu

Other individuals involved in the administration of the degree include:

Director, School of Civil & Environ. Engr.: Linda Nozick, 220 Hollister, 255-3690
Director of Administration: Joe Rowe, 220 Hollister, 255-0549
Administrative Assistant: Jeannette Little, 220 Hollister Hall, 255-3690

Support Staff:

Administrative Assistant: Charissa King, 220 Hollister, 255-2542
Finance Specialist: Stacey Shirk, 220 Hollister, 255-3684
Accounts Coordinator: Megan Keene, 220 Hollister, 255-6192
Facilities Coordinator: Paul Charles, B56 Hollister, 351-3210
IT: Cameron Willkens, B55 Hollister
1.2 The Master of Engineering (M.Eng.) Degree in Engineering Management

The Master of Engineering degree is a coursework and project-oriented program. It requires thirty (30) credit hours consisting of coursework in major and supporting areas, and a project. This generally corresponds to 9 regular courses. In addition, it requires two, one-credit seminars (Professional and Leadership Development Series in the Fall and Project Management Seminar in the Spring), for a total of 32 credits minimum to graduate. The Master of Engineering degree can be completed in two semesters of intensive study, or in three semesters for students who want to include extra electives, make up deficiencies, or need time to adjust to study that departs significantly from their undergraduate experience. Students opting for the three semester program must meet the university requirement of 12 credits minimum per semester.

This program is aimed at engineers who want to be leaders in a technical environment and who want to advance into managerial roles. The dominant organizational structure in engineering firms to accomplish engineering-based work is the project team. The core business of a project team is to organize themselves to use technology and engineering skills to meet the needs of a customer. That customer may be another engineering group within the same company, an external customer (either an individual or another company) or the general public. To develop skills to operate effectively in this environment, the course work and the project address the following focus areas: leading people, advancing your business, and disrupting your field. Given the importance of engineering skills within the project team, this program also requires students to continue to build technical depth in the engineering domain that holds particular interest to them.

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<th>LEAD PEOPLE</th>
<th>ADVANCE YOUR BUSINESS</th>
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<td>• Engineering leadership</td>
<td>• Decision Framing &amp; Analytics</td>
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Specifically, students learn to identify problems, analyze data, and formulate models to understand these problems, and interpret the results of analyses for managerial action. Identifying problems often requires managing data, and transforming data into information. Such data and information can be used as the basis for modeling, and the models generate insights that help us to understand problems and identify opportunities. A foundation of making good managerial decisions is the thread: data → information → models → decisions. Managers also need to communicate the results of such analyses
to their supervisors, to customers, and to other stakeholders who are concerned with decisions and take part in the decision making process.

The business context of the issues and decisions with which students will deal is important, and the program mixes courses from the Engineering College with courses from the Cornell Johnson College of Business and the School of Industrial and Labor Relations to provide that larger context.

Management responsibilities in a technical environment (and increasingly in many business environments) are often focused on projects, where a combination of resources (people, equipment, money, etc.) must be brought together to achieve a specific outcome within both schedule and budget constraints. This importance of projects is reflected in this program through a strong focus on project management – the combination of “people skills” and “technical skills” necessary to make projects successful.

By the end of your Engineering Management degree, you will also develop strong competencies in the following areas:

Because the program is designed to appeal to students from different disciplinary backgrounds, and who are aiming at different career paths, the core tools taught in the program are augmented by a set of track specialization courses that allow students to develop expertise in particular application areas. More detail on how these various program elements are reflected in specific curricular requirements are found in Appendix E.

For some students (especially those whose career interests focus on engineering companies), the Master of Engineering degree in Engineering Management can be viewed as an effective alternative to an MBA degree because it is focused on the mix of technical skills and project management skills that are valued highly in many technical environments. However, for some other students, the combination of the M.Eng. degree and an MBA is attractive, and Cornell offers a joint program between the Engineering College and the Johnson School of Business leading to both degrees (usually after a total of five semesters). Additional details on this joint M.Eng./MBA program are provided in Appendix B.

1.2.1 Preparation

Students from all fields of engineering are welcome in the Master of Engineering program in Engineering Management. The core elements of the program do not require specific knowledge from any particular engineering discipline. However, in keeping with the data → information → models → decisions thread described above, we require that all entering students will have a basic background in probability and statistics. This is generally satisfied by a one-semester undergraduate class that many engineering programs require. At Cornell, the typical courses used by undergraduates to satisfy this requirement are ENGRD 2700, CEE 3040 or ECE 3100. Appendix C describes the material that you should understand to meet this background requirement and to do well in the program.

If you have not had a course in probability and statistics as an undergraduate, you may arrange to take such a course over the summer preceding enrollment as an M.Eng. student, or you will have to take such a course (as an overload) during the first semester of your M.Eng. program. The credits for this
course do not count toward the 30 credits required to complete the degree. We strongly encourage students to satisfy this preparation requirement prior to entering the program because it is used in fall courses, particularly the required course ENMGT 5930.

1.2.2 Major Program Requirements
Note: These requirements are effective for students starting in August 2018 or later.

**Required Courses:**
ENMGT 5900 - Project Management (Fall or Spring, 4 credits)
ENMGT 5910 - Engineering Management Project (Fall or Spring, 4 credits)*
ENMGT 5930 - Engineering Management Methods (Fall, 4 credits)
ENMGT 5940 - Economics and Finance for Engineering Management (Fall, 4 credits)
ENMGT 6090 - Professional Development and Leadership Series (Fall, 1 credit, non-graded)
ENMGT 6091 - Project Management Seminar (Spring, 1 credit, non-graded)

*One out of two of the following:
ENMGT 5970 – Risk Analysis and Management (Spring, 3 credits), or
ENMGT 5980 - Introduction to Decision Analysis (Fall, 3 credits)

*ENMGT 5910 may only be taken in the second semester of your program (or third semester for a three-semester program).

**One course (minimum 3 credits) in individual and/or organizational behavior** (many students take NCC 5530 – Marketing Management; NCC 5540 – Mgmt. and Leading in Organizations; NBA 6630 – Managerial Decision Making; or ILROB 5200 – Organizational Behavior & Analysis; other courses are also possible.)

**9 credits (minimum) of track specialization elective courses** (see Appendix E)

**Meeting the minimum 3-credit requirement:** The program requires that courses chosen to satisfy the finance/accounting and behavior requirements are for a minimum of 3 credits each. You cannot take a half-semester (e.g., 1.5- or 2-credit course) to meet this requirement, even if you meet the overall 30-credit requirement for the degree elsewhere. However, in other colleges instructors sometimes divide a 3-credit course into two 1.5-credit segments, in which case you can meet the 3-credit requirement as long as you take both segments. For the Track Specialization requirement, you are allowed to take courses 1.5-credits or higher.

Appendix E provides the proposal form that must be completed by each student, listing the courses that will be used to satisfy degree requirements.

Appendix F provides course descriptions for the required courses and the most popular choices of courses in accounting/finance and organizational behavior.

The information provided should help you make decisions, but we encourage you to seek guidance from your advisor and other faculty members. An important aspect of the M.Eng. program is interaction between each student and his/her faculty advisor. Your advisor will work with you to develop a program consistent with your career goals and the intent of the M.Eng. program. Also feel free to reach out to the Executive Director as well.
SECTION 2 - PLANNING and REGISTERING for the M.ENG. PROGRAM

Enrolling in the M.Eng. program in Engineering Management will take relatively little time for most of you. You will find the process a little more informal than undergraduate registration, with more freedom to change courses easily during the first three weeks of classes of each semester. The major steps in the process are described in the following sections.

2.1 Assignment of Advisor

You will have an advisor to help you design a program of study and generally to assist you during your stay at Cornell. Advisor assignments are made prior to you beginning your M.Eng. program. You may also request to change your advisor to another Engineering Management faculty member with the permission of the faculty member whom you would like to serve as your new advisor.

The engineering management student cohort will discuss course requirements with Engineering Management faculty as a group at the orientation at the beginning of the semester. Thereafter, you should set up an appointment with your advisor, and take responsibility for registering for all required courses by the add/drop deadline. Additionally, you are responsible for submitting your completed M.Eng proposal form to the Graduate Field Assistant by the deadline date once your advisor has approved and signed off on your proposal form. You are responsible for any changes to your proposal (for example, any changes made to your courses at any time during your program).

2.2 Course Registration

Graduate students must register for courses online by logging into your Student Center with your NetID*. You can begin registering for classes for the fall term on Tuesday, August 14, 2018. Courses may be added online until Thursday, September 6th. They may be dropped online until Wednesday, October 18th.

Any changes in your course registration after the deadlines (i.e., adds/drops, credit hour changes) requires submission of a Course Enrollment Petition to the Engineering Registrar’s office within the College of Engineering. The petition must be signed by both your advisor and the instructor of the course. Please note that petitions are not automatically approved.

*NetID: You should have received your NetID and information from Cornell Information Technologies (CIT) over the summer. If you did not, please contact the CIT Office at HelpDesk@cornell.edu. Please be sure to check your Cornell e-mail regularly.

2.3 Planning Your M.Eng. Program

Please study the pertinent material in this handbook for both required courses and appropriate elective courses before seeing your advisor. It would be worthwhile to spend some time with the online course catalog (https://classes.cornell.edu/browse/roster/FA18) to identify possible courses for both the Fall and Spring terms (the spring roster will be available by mid-October). In addition, students will want to consult the course listing in the Johnson School of Business, the School of Industrial and Labor Relations, and various other departments within engineering.

Program planning is done with the aid of the M.Eng. Proposal Form for Engineering Management (see Appendix E). You will fill this form out with the help of your advisor, who must also sign the form showing his/her approval of your program. Extra proposal forms can be obtained from the Graduate Field Coordinator.
A maximum of two credit hours graded on an S/U basis, such as seminar or their equivalent, may be included provided they are participatory in nature.

2.4 Approval of Your Course Program

After a “final” program of courses for the entire year is agreed upon with your advisor, please submit your Proposal Form to the Graduate Field Assistant by Friday, September 7th for the Fall, 2018 term and Friday, February 8th, 2019 for the spring, 2019 term. It will then be forwarded to the Director of the Engineering Management Program for final approval. A copy of the approved program is returned to both you and your faculty advisor. Original forms stay on file with the Graduate Field Assistant.

2.5 Filing Your Course Program

You have approximately three (3) weeks (until Thursday, September 6, 2018) to enroll online for Fall 2017 classes. This time period allows you to sit in on an extra course or two, if you wish, for a couple of weeks to assist you in making up your mind about your exact program for the term.

2.6 Program Changes

Students often propose changes to their program at the start of their second semester that reflect changes in interests and/or course availability. All changes to your approved M.Eng. program must take the form of a revised proposal. Revised proposal forms must also be approved by your advisor and the Engineering Management Director. It is important that any changes in your program be approved promptly because the current version of your proposal form that is on file serves as a check list for determining compliance with graduation requirements.

2.7 Petitions

Cornell University has a long-standing tradition of considering petitions from students relative to special situations or circumstances that could justify exceptions to the normal rules or requirements. Petitions are considered by the Engineering Management Director. While we are not encouraging use of the petition route to get around requirements, we do want to point out the existence of this process. It gives everyone the opportunity of stating his/her case for special consideration, and therefore it is a very important part of the operational procedures for students attending Cornell University.

2.8 Financial Aid and Work Obligation

Financial aid administered by the College or School can be in the form of fellowships or half-time assistantships. If you have the latter, you will be given eight hours per week of teaching assistant-related duties. MEng students typically serve as graders, prepare class materials, etc. The faculty generally make assistantship assignments during the first two weeks of classes.

2.9 Grade Requirements

The College requires a minimum grade point average of 2.50 for graduation from the Master of Engineering program. Students who are admitted on a Provisional Basis must achieve a 3.00 average during their first term in the M.Eng. program in order to continue in the second term. Typical graduate
student grade point averages are much higher than this. At Cornell, decimal grade points are assigned to grades with (+) or (-), i.e., A+ = 4.3, A = 4, A- = 3.7, B+ = 3.3, etc.

A grade of less than C- in a course will result in no credit being granted toward satisfaction of the 30-hour minimum requirement. However, these courses are included in calculating grade point averages.

2.10  Office Space, etc.

The Engineering Management students have space allocated in 404 Hollister. This space includes:

- Individual study carrels (first come first serve on a daily basis)
- Group study areas
- Sixteen computer workstations (first come first serve on a daily basis)
- Thirty-two individual lockers for storage of books, etc.
- Storage areas above study carrels and computer workstations (first come first serve on a daily basis)
- Laptop charging table
- Printers (available via wireless access from your laptops or directly from the work stations)

We do not recommend leaving valuable items in the lockers or storage space above the workstations as there is no way to lock them.

Entrance into the M.Eng. office is via your ID card. Your ID will also open outside doors to Hollister Hall and the Graduate Student lounge in Hollister Hall.

2.11  Job Placement

We are confident that the background you receive in your M.Eng. program in Engineering Management will be of great assistance to you in the job market. Employers have always been enthusiastic about Cornell graduates with M.Eng. degrees in Engineering Management. Based on our review of recent alums, the following five career pathways are the most common among our graduates. That being said, we see our students pursue a number of successful career pathways outside of these below.

![Career Pathways](example_career_pathways.png)

Figure 1: Example career path trajectories of Engineering Management graduates

During the Engineering Management Professional Development and Leadership series, we will work together with you to set you up for success for your career search.
Also please feel free to reach out to Andrea Ippolito, Executive Director of the Engineering Management Program, to discuss your career goals as well.

SECTION 3 - PROFESSIONAL CONDUCT and SPECIAL NEEDS

3.1 Academic Integrity and Plagiarism

Absolute integrity is expected of every Cornell student in all academic undertakings. Integrity entails a firm adherence to values most essential to an academic community, including honesty with respect to the intellectual efforts of oneself and others. Both students and faculty at Cornell assume the responsibility of maintaining and furthering these values. However, a Cornell student’s submission of work for academic credit indicates that the work is their own. All outside assistance should be acknowledged, and the student’s academic position should be reported truthfully at all times. In addition, Cornell students have the right to expect academic integrity from each of their peers. It is plagiarism for anyone to represent another’s work as their own. As stated in the University Code of Academic Integrity, “The maintenance of an atmosphere of academic honor ... is the responsibility of the student and faculty ...”

Gray areas sometimes exist when students study and work together. It is important that faculty make clear what is expected and that students understand what authorship citations an instructor expects. To become better acquainted with academic integrity responsibilities, each student should have a copy of the Policy Notebook for Students, Faculty and Staff (available in the Dean of Student’s Office). Also, a copy of the “University Code of Academic Integrity” is included in the Handbook of Engineering Students available from the Engineering College’s Office of Admissions and Undergraduate Programs located near the north entrance of Hollister Hall.

3.2 Persons with Special Needs

Cornell University is committed to assisting those persons with disabilities who have special needs. A brochure describing services for persons with disabilities may be obtained from the Office of Equal Opportunity, Cornell University, 234 Day Hall, Ithaca, New York 14853-2801. Other questions or requests for special assistance also should be directed to that office.

APPENDIX A: ENGINEERING MANAGEMENT PROGRAM FACULTY AND THEIR INTERESTS

Ricardo A. Daziano, Assistant Professor (Ph.D. Université Laval): pro-environmental preferences, sustainable travel behavior, renewable energy, environmentally-friendly energy sources.

Huaizhu "Oliver" Gao, Associate Professor (Ph.D. California/Davis): systems engineering, statistical modeling, transportation and air quality.

Andrea Ippolito, Lecturer: Engineering Management, entrepreneurship, innovation, product management, healthcare systems.

Robert Newman, Senior Lecturer: Engineering Management, business development, organizational and team development, engineering management, emotional intelligence, entrepreneurship.
Linda K. Nozick, Professor (Ph.D. Pennsylvania): Systems engineering, transportation and logistics, engineering management.

Patrick M. Reed, Professor (Ph.D. Illinois): Environmental and water resources systems; multiobjective planning and management, evolutionary computation; high-performance computing; uncertainty in decision making.

Samitha Samaranayake, Assistant Professor (Ph.D. University of California, Berkeley): Systems engineering and transportation

Jery R. Stedinger, Professor (NAE, Ph.D. Harvard): Stochastic hydrology; water resource systems planning and operations; risk analysis and management.

Francis M. Vanek, Senior Lecturer (Ph.D. Pennsylvania): Energy, environment, and transportation.

APPENDIX B: FIVE SEMESTER M.ENG./MBA PROGRAM

What is it?

A joint venture between the College of Engineering and the Johnson Graduate School of Management (JGSM) that allows students to acquire a Master of Engineering degree and an MBA degree in 5 semesters (usually based on Fall admission to the M.Eng. program). The dual-degree program consists of 75 credit hours, 30 of which comprise the regular two-semester M.Eng. program. For those admitted to the MBA program, the JGSM allows some (occasionally all) of these M.Eng. credits to be transferred to the MBA program, usually resulting in saving one semester’s time over taking the M.Eng. and MBA degree programs separately.

What are the requirements?

Applicants must have already earned a baccalaureate degree in engineering, applied science, or equivalent from Cornell or elsewhere and be accepted for admission or presently enrolled in the M.Eng. program. The two programs require separate application forms and review processes, and materials submitted to one program are not available to the other. The JGSM places great emphasis on relevant work experience, and this will be taken into consideration when evaluating applications. All requirements of the Master of Engineering program are to be completed. No credit toward the M.Eng. degree is allowed for coursework done outside Cornell. All requirements of the Master of Business Administration curriculum are to be completed. Coursework done outside Cornell normally will not be credited toward the MBA degree.

Please review the following steps if you are interested in this program, (the following dates are based on Fall enrollment):

a. If you have been admitted to or are attending the M.Eng. program, formally apply to the Johnson Graduate School of Management by the second semester of your M.Eng. program at the latest. You must fill out a separate JGSM application form and pay their application fee. You should also notify your M.Eng. advisor of your intention to do the MBA program so your advisor can take this into consideration when planning your M.Eng. program schedule.
b. If you have not already done so, apply to take the GMAT or GRE (either acceptable) and is required by JGSM. January of your M.Eng. year is your last possible test date. Have the scores directed to JGSM

If you are admitted to the JGSM, your Master of Engineering degree will be awarded when all requirements of that degree are completed (usually after 2 semesters), and the Master of Business Administration degree will be awarded when all requirements of that degree are completed (usually after 3 more semesters). The two degrees cannot be awarded simultaneously.

In general, financial aid is not awarded to those doing the MBA portion of the program except through the Knight Joint Degree Scholarship Program, which has very strict requirements. Information and an application to the Scholarship Program is available on the web at:

http://www.engineering.cornell.edu/academics/graduate/financial_aid/meng/scholarship.cfm

Questions about this Scholarship Program should be directed to the Office of Research and Graduate Studies, engr_grad@cornell.edu)

APPENDIX C: MASTERS IN PUBLIC ADMINISTRATION (M.P.A.) FROM THE CORNELL INSTITUTE FOR PUBLIC AFFAIRS (CIPA)

After the award of the M. Eng. degree, Engineering Management students who aspire to a leadership or management position in formulating, implementing or evaluating public policies can benefit from a program that offers an accelerated path to a Masters in Public Administration (M.P.A.) from the Cornell Institute for Public Affairs (CIPA). CIPA offers a flexible and challenging two-year program of graduate professional studies in public affairs that prepares degree recipients for careers in public affairs, public administration, and public policy.

Concentration areas offered in CIPA include Environmental Policy; Science, Technology and Infrastructure Policy; Economic and Financial Policy; International Development; and Public and Nonprofit Management.

The two degree programs (MEng and M.P.A.) have separate admission processes; so you may apply to the Accelerated M.P.A. program upon completion of your first semester in the M.Eng program. The M.Eng students who possess an M.Eng. can obtain the M.P.A. degree in three additional semesters. Applicants should plan on meeting with the CIPA Director of Graduate Studies to discuss which M.Eng credits would be transferable for the MPA program.

Please contact the C.I.P.A. Office at 607-255-8018 or cipa@cornell.edu to set up an appointment. More information is available on the CIPA website at http://www.cipa.cornell.edu.

APPENDIX D: PREREQUISITE SKILLS IN PROBABILITY AND STATISTICS

Engineering Management requires that an engineer deal with variation, variability and uncertainty. Illustrative issues of concern include estimates of the time to complete tasks in project planning and scheduling; the prices for goods and services; the demand for goods and services; and the performance of a range of systems and other forces that effect an organization. Thus Engineering Management students need to know how to use the language of probability to describe variability and uncertainty, and to help resolve the challenges faced by their organization. They need to understand
how statistical concepts help them resolve what information can be extracted from available data, and how to determine and describe the precision of estimated quantities.

Our Engineering Management courses provide examples of these issues, and reinforce and advance these skills. But we depend upon all the Engineering Management students to begin the program with a basic understanding of probability and statistics, consistent with what would be included in an undergraduate treatment of the subject. Specific concepts and ideas students should have when entering the program include the basic concepts and methods of probability, along with an understanding of the idea of statistical estimation, construction of confidence intervals, hypothesis testing, and linear regression analysis. If the student does not complete a course with this material prior to entering, they will be required to take a course while in the program. This course will require additional course work beyond the 30 credit hours required, and may delay completion of the program.

Specifically we expect the following. [For clarification we provide references to sections in Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 9th edition, Duxbury, Belmont, CA, 2015. See also http://allpsych.com/stats/index.html]

1. Students should know the 3 basic axioms for probability. [Devore §2.1-2.2]
   \[ P(A) \geq 0; \quad P(S) = 1; \text{ for } A \text{ and } B \text{ disjoint, } P[A \cup B] = P[A] + P[B] \]

2. Students should know how to calculate the probability of events consisting of unions \([A \cup B]\), intersections \([A \cap B]\), and complements \([A' = S - A]\), of events of known probability. They should be able to use the Total Probability Theorem and Bayes Theorem to calculate probabilities and conditional probabilities of different events \([P(A|B) = P(A \cap B)/P(B)]\). [Devore §2.2-2.5]

3. Students should know definitions of the cumulative distribution function (cdf) \(F_X(x)\) and probability density function (pdf) \(f_X(x)\) for continuous univariate random variables; the properties of each; and how to use these functions to calculate the probabilities for events such as \(P\{a \leq X \leq b\}\). [Devore §4.1-4.2]

4. Students should know the definitions and properties of the mean \(\mu\), variance \(s^2\), and correlations \(r\); how to compute the univariate “moments” given a pdf; and how to compute the mean and variance for linear functions and linear combinations of random variables. [Devore §5.1-5.2, 5.5]

5. Students should know the some properties of a Normal distribution, the form of the pdf, and how to calculate quantiles and the probability of events such as \(a \leq X \leq b\) for \(X \sim N[\mu, \sigma^2]\). Students should be able to state the Central Limit Theorem and know when it applies. [Devore §4.3, 5.4]

6. Students should know the mean, variance and probability mass function for the discrete binomial and the Poisson distributions, and be able to use those relationships to compute probabilities for a range of events. [Devore §3.1-3.4, 3.6]

7. Students should know the concept of an estimator, and the sampling properties of the sample mean \(\bar{X}\) for a set of data. [Devore §5.4, 6.1-6.2]

8. Students should know how to construct confidence intervals for the mean of a Normal distribution with small samples. [Devore §7.1-7.3]

9. Students know how to structure a statistical decision problem as a choice between two hypotheses and how that choice relates to probabilities of type I (denoted \(\alpha\)) and II (denoted \(\beta\)) errors; students should know how to perform a simple one-sample or two-sample t test. [Devore §8.1-8.2]
10. Students should know why statisticians sometimes summarize results by a *P-value*, as well as what a *P*-value is, and how to calculate it. [Devore §8.4]

11. Students should understand the form of and assumptions employed with the *basic linear model* \( Y = \alpha + \beta x + \varepsilon \), with independent additive normal errors \( \varepsilon \). [Devore §12.1]

12. Students should be able to calculate *least-squares estimators* of the two coefficients \( \alpha \) and \( \beta \), and construct hypothesis tests on the parameters. Students should know the *definition of \( R^2 \)*, what it represents, and how to calculate it. Students should know the definition and meaning of the *correlation coefficient*, and be able to calculate its estimator \( r \). [Devore §12.2-12.5]

**APPENDIX E: Program Requirements, Link to Proposal Form for M.Eng. Degree in Engineering Management, and Track Specialization Electives**

Below is the link to the EM Proposal form that you must complete and add to your Cornell Box folder that you recently received access to for advisor approval. Please note that any changes made to your proposal form must be approved by your advisor along with an updated copy of your proposal form.

**EM PROPOSAL FORM AY 18-19**

1. **One course in individual and/or organizational behavior** is required. Suggested courses include:

   - ENMGT 3000  Entrepreneurship and Private Equity
   - HADM 6110  Negotiations in the Hospitality Industry
   - ILROB 5200  Organizational Behavior & Analysis (Note: Must be admitted in person by prof)
   - NBA 5150  Leadership Theory and Practice (Note: This is an intensive, 1-week course that meets before the semester starts, so if you choose to take it you would need to make travel plans accordingly. We highly recommend you take it in the Fall semester because the Spring semester typically is very popular and has a wait list).
   - NBA 6090  Digital Marketing
   - NBA 6200  Marketing Research
   - NBA 6540  Power and Politics in Organizations (Note: You must take both the first and second 7-week sections of this course to meet the 3-credit requirement)
   - NBA 6630  Managerial Decision Making
   - NCC 5530  Marketing Management
   - NCC 5540  Management & Organizations
   - PADM 5570  Corporate Responsibility

2. **9-credits in Engineering Management Track Specialization elective courses are required**

Each student’s program must include at least 9-credits worth of electives selected to provide a track area of specialization. Students can combine two 1.5 or higher credit behavior courses, as long as they meet or exceed 3 credits. We have put together six track areas of specialization below tied to common career paths of Engineering Management degree graduates. Any 5000 or 6000-level College of Engineering non-seminar technical 3 credits or higher course is acceptable. Courses outside of the College of Engineering and not listed below must be approved by the Director of the Engineering Management program via a course petition. The course petition must include a detailed syllabus of the
technical content to be covered. You are also welcome to mix and match courses from different headings or choose courses aligned with your own interests to best serve your professional goals.

You will need to get your specialization track and classes approved by your faculty advisor.

Some additional things to think about when selecting your specialization track electives:
1. Make sure to comb through the course catalog because it is constantly getting updated with new courses or courses are being iterated upon/removed.
2. Make sure to check the prerequisites. If you don’t have the prerequisites, make sure that you have the permission of the instructor, which you can get by emailing them. Also don’t be afraid to show up on the first day of classes too (along with emailing them).
3. Many Johnson school courses are only 1.5 credits, which allows you to take more, but make sure that you meet the requirement of 9 credits worth of specialization electives.
4. Make sure to double check when courses are offered because many courses are only offered in the Fall or Spring, but not both.
5. For your specialization electives, courses should be above the 5000 level, which means that they are at the graduate level. 4000 level engineering courses may be acceptable if there is no course on the same topic at a higher level; ask your advisor.
6. You can mix and match across track specializations or build your own track!

The breakdown of the pre-approved electives for each track are below. Please note that course offerings change from semester to semester.

**Consulting**
CEE 5970 Risk Analysis & Management (If not used as a core course)
CEE 5980 Intro to Decision Analysis (If not used as a core course)
CEE 6640 Microeconomics of Discrete Choice
NBA 5000 Intermediate Accounting
NBA 5020 Managerial Accounting and Reporting
NBA 5061 Comprehensive Financial Statement Analysis
NBA 5090 Advanced Financial Statement Analysis (1.5 credits)
NBA 5110 Financial Modeling (1.5 credits)
NBA 5120 Applied Portfolio Management (1.5 credits)
NBA 5130 International Finance Cases (1.5 credits)
NBA 5140 Ethics and Corporate Culture (1.5 credits)
NBA 5200 Retail Operations (1.5 credits)
NBA 5245 Introduction to Macroeconomics
NBA 5270 Applied Economic Analysis
NBA 5305 Entrepreneurial Finance (1.5 credits)
NBA 5420 Investment and Portfolio Management
NBA 5260 Leaders in Emerging Markets (1 credit)
NBA 5360 Investment Banking Essentials (1.5 credits)
NBA 5550 Fixed Income Securities and Interest Rate Options
NCC 5560 Managerial Finance (if did not take already for finance requirement)
NCC 5580 Managing Operations
NBA 5911 Risk Management in Emerging Markets
NBA 5980 Behavioral Finance (1.5 credits)
NBA 6090 Digital Marketing (1.5 credits)
NBA 6200 Marketing Research
NBA 6220 Marketing Strategy (1.5 credits)
NBA 6250 International Marketing (1.5 credits)
NBA 6390 Data-Driven Marketing (1.5 credits)
NBA 6430 Managerial Spreadsheet Modeling (1.5 credits)
NBA 6560 Valuation Principles (1.5 credits)
NBA 6630 Managerial Decision Making
NBA 6650 Strategic Management of Technology and Innovation
NBA 6730 Derivatives Securities Part I (1.5 credits)
NBA 6740 Derivatives Securities Part II (1.5 credits)
NBA 6780 Advanced Private Equity - Negotiations and Structuring (2 credits)
NBA 6410 Supply Chain Management
NBA 6820 Negotiation 1: Negotiation Essentials (1.5 credits)
NBA 6880 Financial Distress, Bankruptcy and Restructuring (1.5 credits)
NBA 6930 Strategy and Tactics of Pricing (1.5 credits)
NCC 5000 Financial Accounting (2.5 credits, if not using for Finance requirement)
NCC 5530 Marketing Management (if not using for Org Behavior requirement)
PADM 5755 Infrastructure financing

Product Management and Entrepreneurship
AEM 6385 Entrepreneurial Strategy
AEM 6395 Technology Strategy
ENMGT 5000 Entrepreneurship and Private Equity
ENMGT 5920 Product Management
HADM 6140: Corporate Entrepreneurship
HADM 6130 Entrepreneurial Management
HADM 6211 Entrepreneurial Finance
HADM 6800 Law for Entrepreneurs
LAW 6335 Emerging Growth Companies and Venture Capital Financing
NBA 5100 Social Entrepreneurship (1.5 credits)
NBA 5180 Design and Innovation (1.5 credits)
NBA 5305 Entrepreneurial Finance (1.5 credits)
NBA 5590 The Venture Capital Industry and Private Equity Markets (0.5 credits)
NBA 5630/LAW 6491 The IPO & Mergers & Acquisitions Process
NBA 6029 Leading Agile Innovation (1.5 credits)
NBA 6090 Digital Marketing (1.5 credits)
NBA 6230 / NBA 6330 eLab
NBA 6390 Data-Driven Marketing (1.5 credits)
NBA 6560 Valuation Principles (1.5 credits)
NBA 6570 Entrepreneurial Marketing (1.5 credits)
NBA 6620 Product Marketing Insights
NBA 6650 Strategic Management of Technology and Innovation
NBA 6820 Negotiation 1: Negotiation Essentials (1.5 credits)
NBA 6930 Strategy and Tactics of Pricing (1.5 credits)
NCC 5530 Marketing Management

Real Estate and Construction Management
CEE 5950 Construction Planning and Operations
CEE 6730 Design of Concrete Structures
CRP 5320 Real Estate Development Process I (1.5 credits each, must take part II)
CRP 5321 Real Estate Development Process II (1.5 credits each, must take part I first)
CRP 5560 Creating the Built Environment
CRP 5590 Legal Aspects of Land Use Planning
CRP 5590 Legal Aspects of Land Use Planning
HADM 6200 Principles of Real Estate
HADM 6211 Entrepreneurial finance
HADM 6280 Real Estate Finance and Investments
HADM 6500 Sustainable Development
HADM 6570 Project Mgt for Real Estate Development
HADM 6580 Advanced project management for real estate development
PADM 5755 Infrastructure financing
SYSEN 5740 Design Thinking for Complex Systems

Engineering Leadership
General
HADM 6155 Women in Leadership
HADM 6835 Leading and Managing Teams
ILRHR 7451 Leadership Assessment for Managers
NBA 5150 Leadership Theory and Practice (take in Fall)
NBA 6410 Supply Chain Management
NBA 6630 Managerial Decision Making
NBA 6650 Strategic Management of Technology and Innovation
NBA 6700 Leadership, Ethics and Organizations (1.5 credits)
NBA 6820 Negotiation 1: Negotiation Essentials (1.5 credits)
NCC 5580 Managing Operations
ORIE 5100 Design of Manufacturing Systems
ORIE 5122 Inventory Management
ORIE 5140 Model based systems engineering
ORIE 5300 Optimization I
ORIE 5380 Optimization Methods
ORIE 5580 Simulation Modeling and Analysis
ORIE 5581 Monte Carlo Simulation
ORIE 6741 Bayesian Machine Learning

Healthcare/Biomedical
BME 5310 Machine Learning with Biomedical Data
BME 5390 Biomedical Materials & Devices for Human Body Repair
BME 6210 Engineering Principles for Drug Delivery
BME 6650 Principles of Tissue Engineering
BME 7310 Advanced Biomedical Engineering Analysis of Biological Systems
Analytics

This is a popular track to do if you are interested in supply chain management too.

CEE 5970 Risk Analysis & Management (If not used as a core course)
CEE 5980 Intro to Decision Analysis (If not used as a core course)
CEE 6000 Numerical Techniques for Engineers
CEE 6620 Networks
CRP 5080 Introduction to Geographic Information Systems for planners
CS 5320 Introduction to Database Systems
CS 5150 Software Engineering
CS 5320 Introduction to Database Systems
CS 5780 Machine Learning
FDSC 4210 Food Engineering Principles (this is a popular course for students interested in Food Product Supply Chain Management)
INFO 5306 Crowdsourcing and Human Computation
INFO 6113 Technology and Law Colloquium
INFO 6120 Ubiquitous Computing
INFO 6220 Networks II
INFO 6260 Networks, Crowds, and Markets
INFO 6420 Human Robot Interaction - Research and Design
M&AE 4780 Feedback Control Systems
NBA 5301 Intermediate Design and Programming for Web
NBA 6010 Electronic Commerce
NBA 6340 Customer Strategy and Analytics (1.5 credits)
NBA 6390 Data-Driven Marketing (1.5 credits)
NBA 6410 Supply Chain Management
NBA 6430 Managerial Spreadsheet Modeling (1.5 credits)
NBA 6550 Introduction to Statistical Programming and SQL (1.5 credits)
NBA 6920 Advanced Data Analytics Applications and Methods (1.5 credits)
NCC 5530 Marketing Management
NCC 5580 Managing Operations
ORIE 5100 Design of Manufacturing Systems
ORIE 5122 Inventory Management
ORIE 5126 Principles of Supply Chain Management
SYSEN 5200 Systems Analysis Behavior and Optimization
SYSEN 5220 Systems Dynamics
SYSEN 5240 Search and Optimization with Metaheuristics
SYSEN 5300 Systems Engineering and Six Sigma for the Design and Operation of Reliable Systems
SYSEN 5400 Theory and Practice of Systems Architecture
SYSEN 5500 Systems Modeling Language: Fundamentals and Practice
SYSEN 5740 Design Thinking for Complex Systems
SYSEN 5940 Creativity and Innovation within Systems Engineering
SYSEN 6410 Multiobjective Systems Engineering Under Uncertainty
SYSEN 6880 Industrial Big Data Analytics and Machine Learning
SYSEN 5200 Systems Dynamics
SYSEN 5300 Systems Engineering and Six Sigma for the Design and Operation of Rel Systs
SYSEN 5400 Design & Operation of Rel Systs Theory & practice of systems architecture
SYSEN 5400 Theory and Practice of Systems Architecture
Sustainability and Renewable Energy

A&EP 4840 Controlled Fusion
AEP 5500 Physics of Renewable Energy
BEE 4010 Renewable Energy Systems
BEE 4750 Environmental Systems Analysis
BEE 4870 Sustainable bioenergy systems
CEE 6530 Water Chemistry for Environmental Engineering
CEE 6550 Transport, Mixing and Transformation in the Environment
CEE 6560 Physical/Chemical Processes
CEE 6570 Biological Processes
CEE 6930 Public Systems Modeling
CEE 6200 Water Resource Systems Engineering
ChemE 6610 Air Pollution Control
ChemE 6640 Energy Economics
ChemE 6650 Energy Engineering
ChemE 6610 Air Pollution Control Manufacturing Management
ChemE 6660 Analysis of Sustainable Energy Systems
ECE 4510 Electric Power Systems I
ECE 4520 Electric Power Systems II
MAE 5010 Future Energy Systems
MAE 5020 Wind Power
MAE 5430 Combustion processes
MSE 5150 Structures & materials for sustainable energy systems
MSE 5330 Materials for energy production, storage, conversion, and distribution

APPENDIX F: 2018-19 COURSES OF STUDY FOR ENMG 59XX SERIES AND OTHER KEY COURSES

CEE Courses

ENMG 5900: Project Management
Fall & Spring, 4 credits. Prerequisite: permission of instructor.

Core graduate course in project management for people who will manage technical or engineering projects. Focuses both on the “technical” tools of project management (e.g., methods for planning, scheduling, and control) and the “human” side (e.g., forming a project team, managing performance, resolving conflicts), with somewhat greater emphasis on the latter.

ENMG 5910: Engineering Management Project
Fall and Spring, 4 credits. Prerequisite: permission of instructor.

As Engineering Managers, you need to embrace both technical and business skills to tackle complex, sociotechnical challenges, while staying on top of the current pace of technological change. In this Engineering Management project course, we are bridging from your coursework to your role as an engineering manager. To get there, you will practice the tools, themes, and techniques learned in your Engineering Management coursework through the scaffolding of a large project. In ENMG 5910, you will work in teams to participate in a project in collaboration with an industry partner. You will perform an intensive evaluation of some mixture of the technological and management aspects of a major
engineering project or system, conducted with a team of students. This project typically incorporates some combination of economic and financial analysis, integration of components into a large-scale system, or technology feasibility.

**ENMGT 5930: Engineering Management Methods: Data, Information, and Modeling**  
Fall, 4 credits. Prerequisites: CEE 3040 or equivalent.

Methods for managing data and transforming data into information. Modeling as a means to synthesize information into knowledge that can form the basis for decisions and actions. Application of statistical methods and optimization to managerial problems in project design, scheduling, operations, forecasting, and resource allocation.

**ENMGT 5940: Economics and Finance for Engineering Management**  
Fall, 4 credits.  
An engineering case based exploration of economic models and methods used in analyses, comparisons, and decision making by engineers and engineering teams. Emphasis will be placed not only on the important calculations, but on understanding, communicating and recording their findings, related assumptions, risks, external considerations and situational awareness.

**ENMGT 5970: Risk Analysis and Management**  
Spring, 3 credits. Prerequisite: introduction to probability and statistics (e.g. CEE 3040, ENGRD 2700, ILRST 2100, or AEM 2100); two semesters of calculus; senior or graduate standing, or permission of instructor. J.R. Stedinger.

Develops a working knowledge of risk terminology and reliability engineering, analytic tools and models used to analyze environmental and technological risks, and social and psychological risk issues. Discussions address life risks in the United States historical accidents, natural hazards, threat assessment, transportation risks, industrial accidents, waste incineration, air pollution modeling, public health, regulatory policy, risk communication, and risk management.

**ENMGT 5980: Introduction to Decision Analysis**  
Fall, 3 credits. Prerequisite: introduction to probability and statistics course such as CEE 3040, ENGRD 2700, ILRST 2100, BTRY 3010, or AEM 2100. Enrollment is limited to: seniors and graduate students; or permission of instructor.

Framework to structure the way we think about decision situations that are complicated by uncertainty, complexity, and competing objectives. Specific decision analysis concepts and tools, such as decision trees, sensitivity analysis, value of information, and utility theory. Applications to all areas of engineering and life. Includes a group project to analyze a real-world decision.

**ENMGT 6090: Professional Development and Leadership Series**  
In the Professional and Leadership Development Course, Engineering Management Master of Engineering students will identify the goals for their career and engage in several career development support services, such as networking, interviewing, resume and cover letter writing, and negotiation workshops. In addition, they will engage in a leadership development series to help them further build their engineering management and leadership competencies. Through a variety of tools, one-on-one coaching, workshops, events, and other resources, this course will help students develop and practice critical career management skills, along with build their confidence to find a career opportunity best suited to their interests and needs.

**ENMGT 6091: Project Management Seminar**
Weekly seminar aimed at M.Eng. students, in particular in the engineering management program. Weekly speaker will come from different engineering applications and discuss insights into project management.

*Individual and Organizational Behavior Courses*

**NCC 5530: Marketing Management**

Fall & Spring, 3 credits. Course intended for non-Johnson School students only.

The course addresses controllable and uncontrollable marketing variables that managers in multi-product firms face in today’s business environment. Topics include customer behavior, product planning, distribution, advertising and promotion, pricing, and competitive strategy.

**Appendix G: Course resources**

Please note that courses listed may not be available every Fall and Spring. Please be sure to check with University Class Roster for the most up to date course listing: [https://classes.cornell.edu/browse/roster/FA18](https://classes.cornell.edu/browse/roster/FA18).