

QNT 2020

Title: Foundations of Predictive Analytics and Decision Modeling

Prerequisites: (MTH 2000 or MTH 2001 or MTH 2003 or MTH 2009) and STA 2000

3.0 credits; 3.0 hours

Course Description: Students will develop quantitative reasoning skills necessary for success in business. Proficiency in the foundations of predictive analytics and decision modeling is the central focus. Students will learn to model a wide range of business decisions through case studies, data analysis, spreadsheet modeling, and interpretation of business significance. Students will further develop their statistical thinking skills through the study of predictive modeling for business using multiple regression. Variation, interpretation of models and model output, model building with spreadsheets, and regression assumption-checking are stressed. Throughout the course, students will build quantitative literacy skills through writing about analytics, model building, and interpreting quantitative information to understand and use data in managerial decisions.

Course Learning Goals: Upon successful completion of the course, students will, with proficiency, be able to:

1. Use quantitative reasoning skills needed to interpret data and statistical analyses to solve business problems.
2. Employ statistical methods and multiple linear regression to analyze data and make predictions for business.
3. Design, build, and test quantitative models for business decision-making using spreadsheets and other technologies.
4. Interpret and communicate quantitative and statistical information in order to enable managerial decisions.

For BBA program learning goals, please see “Assurance of Learning.”

Required Materials:

- [*Introduction to Management Science: A Modeling and Case Studies Approach with Spreadsheets*](#), 6th ed. with Connect by Hillier & Hillier (McGraw Hill, 2019), Chapters 1, 2, 3, 4, and 8.
- [*Essential Statistics in Business and Economics*](#), 3rd ed. with Connect by Doane & Seward. (McGraw Hill, 2020, ISBN 978-1-260-23950-8), Chapters 3, 4, 7, 8, 9, 12, 13.
- SAM access code by Cengage Learning (students buy once and use it for SAM assignments throughout the BBA core courses).

COURSE SCHEDULE AND OUTLINE

Session	Learning Objectives	Reading	Deliverables ¹
	Pre-course online diagnostic test of mastery of prerequisite business statistics (STA 2000 or equiv.)		
1	Statistical Foundations of Predictive Modeling: Visualizing, Organizing, and Describing Data <u>Learning Objectives:</u> <ul style="list-style-type: none"> ● Organize data; describe sources and types of data used in business. ● Visualize data; create tables and charts for numerical and categorical data using Excel. ● Describe the properties of central tendency, variation, covariance, and shape in numerical data. ● Compute and explain the descriptive summary measures for a population. 	Doane & Seward, Ch 3, 4	SAM project 1 for MS-Excel skills Online Assessment 1: “Describing Data Visually” and “Descriptive Statistics”
2	Statistical Foundations of Predictive Modeling: Continuous Distributions, Sampling Distributions <u>Learning Objectives:</u> <ul style="list-style-type: none"> ● Use the normal distribution to solve business problems. ● Understand the normal probability plot; compute probabilities from the normal distribution. ● Describe a sampling distribution. ● Compute probabilities related to the sample mean and the sample proportion. ● Explain the Central Limit Theorem. 	Doane & Seward, Ch 7, 8.1-8.3	Online Assessment 2: “Continuous Probability Distributions” and “Sampling Distributions”
3	Statistical Foundations of Predictive Modeling: Hypothesis Testing and Confidence Intervals <u>Learning Objectives:</u> <ul style="list-style-type: none"> ● Build and interpret confidence interval estimates for the mean and the proportion. ● Build and interpret hypothesis tests to test a mean or proportion; understanding the assumptions and pitfalls of hypothesis testing. 	Doane & Seward, Ch 8.4-8.10, 9	SAM project 2 for MS Excel skills Online Assessment 3: “Estimation” and “One-Sample Hypothesis Tests”
4	Statistical Foundations of Predictive Modeling: Simple Linear Regression <u>Learning Objectives:</u> <ul style="list-style-type: none"> ● Use simple linear regression analysis to predict the value of a dependent variable based on a single independent variable. ● Interpret the meaning of the regression coefficients. 	Doane & Seward, Ch 12	Online Assessment 4: “Simple Linear Regression”

¹ “Online assessments” may be delivered through a publisher’s platform (such as McGraw Hill Connect) or through Blackboard (with question banks developed by the QNT 2020 course coordinator).

	<ul style="list-style-type: none"> ● Evaluate the assumptions of regression analysis and know what to do if they are violated. ● Make inferences about the slope and correlation coefficient; t-test and p-value; R-squared. ● Estimate mean values and predict individual values. ● Determine when it is valid to infer that one thing causes another; causation vs. correlation. ● Describe how simple regression is conducted and analyzed in MS-Excel 3 ways: the Data Analysis ToolPak, “Add Trendline”, and TREND and FORECAST functions. 		
5, 6	<p>Least-Squares Predictive Modeling</p> <p><u>Learning Objectives:</u></p> <ul style="list-style-type: none"> ● Explain the multiple regression model and the related least squares point estimates. ● Interpret the managerial significance of model coefficients. ● Compute and interpret the multiple and adjusted multiple coefficients of determination; R-squared and adjusted R-squared. ● Explain the assumptions behind multiple regression and calculate the standard error. ● Test the overall significance of a multiple regression model with an F test in. ● Build and interpret a multiple regression model using the MS-Excel Data Analysis ToolPak. 	Doane & Seward, Ch 13.1, 13.2	SAM project 3 for MS Excel skills
7, 8	<p>Understanding the significance of independent variables and the uncertainty of model predictions</p> <p><u>Learning Objectives:</u></p> <ul style="list-style-type: none"> ● Test the significance of a single independent variable. ● Interpret T-tests on model coefficients and interpret the managerial significance of p-values. ● Find and interpret a confidence interval for a mean value and a prediction interval for an individual value. ● Analyze independent variables and prediction intervals in MS-Excel. 	Doane & Seward, Ch 13.3, 13.4	Online Assessment 5: “Multiple Regression” (preliminary material in §13.1-13.4)
9, 10	<p>Modeling Qualitative Independent Variables</p> <p><u>Learning Objectives:</u></p> <ul style="list-style-type: none"> ● Incorporate categorical “dummy” variables to model qualitative independent variables. ● Interpret the meaning of dummy variables in a regression model. ● Analyze a model with categorical data in MS-Excel. 	Doane & Seward, Ch 13.5	Online Assessment 6: “Categorical Variables”

11, 12	<p>Nonlinear and Interaction Effects of Predictors</p> <p><u>Learning Objectives:</u></p> <ul style="list-style-type: none"> ● Build a nonlinear model and perform basic tests for nonlinearity. ● Test for and interpret the interaction between two predictors. ● Describe the difference between multiplicative and additive models. ● Analyze a nonlinear regression in MS-Excel. 	Doane & Seward, Ch 13.6	Online Assessment 7: “Nonlinear models” (§13.6)
13, 14	<p>Building and Validating Multiple Regression Models</p> <p><u>Learning Objectives:</u></p> <ul style="list-style-type: none"> ● Describe multicollinearity and validate a multiple regression model. ● Analyze residuals to check the assumptions of multiple regression. ● Practice, practice, practice model evaluation on various data sets in MS-Excel. ● Midterm exam review. 	Doane & Seward, Ch 13.7, 13.8	Project 1: Multiple regression modeling assignment.
15	Midterm Exam		
Session	Learning Objectives	Reading	Overview of Business Applications in Hillier & Hillier 6th and Deliverables
16	<p>Introduction to Business Decision Modeling</p> <p><u>Learning Objectives:</u></p> <ul style="list-style-type: none"> ● Describe the difference between predictive analytics (multiple regression) and prescriptive analytics (optimization). ● Explain what a mathematical decision model is. ● Understand the difference between deterministic and uncertain/risky business problems; simultaneous (one-time) vs. sequential decisions. ● Identify the levels of annual savings that prescriptive analytics has historically provided organizations. 	Hillier & Hillier, Ch 1.1-1.5	<p>Managerial accounting (break-even analysis), supply chain management (shipping logistics decisions), finance (make-or-buy cash-flow decisions), financial accounting (profit and loss financial reporting).</p> <p>Online assessment 8: “Difference between predictive and prescriptive analytics”</p>
17	<p>Business Decision Modeling: Basic Concepts</p> <p><u>Learning Objectives:</u></p> <ul style="list-style-type: none"> ● Explain what a (linear) decision model is. ● Identify the key questions to be addressed in formulating any decision model: Decision variables, problem data, objective function, and constraints. ● Formulate a basic (linear) decision model in algebraic form and in a spreadsheet (starting from a problem description and data). ● Present the algebraic form of a (linear) decision model from its spreadsheet formulation, and vice versa. 	Hillier & Hillier, Ch 2.1-2.3	Marketing-operations interface (product-mix decisions), marketing (advertising-mix decisions; market research decisions), finance (investment decisions), human resources (call center staffing decisions).
18	<p>Business Decision Modeling: Basic Concepts (cont’d.)</p> <p><u>Learning Objectives:</u></p>	Hillier & Hillier, Ch 2.4	Online assessment 9: “Basic Decision Models” (§2.1-2.4)

	<ul style="list-style-type: none"> ● Apply the graphical method to solve and interpret a 2-variable linear decision problem. ● Develop intuition for spreadsheet solutions from the graphical solution. 		
19, 20	<p>Business Decision Modeling: Basic Concepts (cont'd.)</p> <p><u>Learning Objectives:</u></p> <ul style="list-style-type: none"> ● Name and identify the purpose of the 4 kinds of spreadsheet cells using in (linear) decision spreadsheet models. ● Model continuous and integer decision variables. ● Use MS-Excel Solver to solve (linear) decision models. ● Practice modeling a variety of multiple decision problems. 	Hillier & Hillier, Ch 2.5-2.8	Online assessment 10: “Modeling decisions in MS-Excel” (§2.5-2.8)
21, 22, 23	<p>Business Decision Models: Formulation and Applications</p> <p><u>Learning Objectives:</u></p> <ul style="list-style-type: none"> ● Recognize the various kinds of managerial problems where linear decision models and linear optimization can be applied. ● Describe 5 major categories of linear decision problems, including their identifying features. ● Formulate linear decision models in MS-Excel from a (text) description of any of the above categories. ● Describe the differences among resource constraints, benefit constraints, and fixed-requirement constraints, including how they arise. ● Identify the kinds of MS-Excel functions that linear decision spreadsheet models use for their output cells. ● Identify the 4 components of any linear programming model and the kind of spreadsheet cells used for each component. ● Understand the difference between continuous and integer decision variables. 	Hillier & Hillier, Ch 3.1-3.7	<p>Finance (capital budgeting decisions, investment decisions; cash flow optimization), marketing (advertising-mix decisions; market research planning decisions), marketing-operations interface (product-mix decisions), operations (operational capacity expansion decisions; workforce scheduling decisions), supply chain management (warehouse selection decisions; logistics/transportation decisions; supplier selection decisions), human resources (worker assignment decisions; union vs. non-union workforce sourcing decisions), technology management (product formulation decisions), public policy (student school assignments), project management (project bidding decisions), sustainable business (environmental reclamation decisions).</p> <p>Online assessment 11: “Intermediate decision modeling skills” (§3.1-3.7)</p>
24, 25	<p>The Art of Modeling with Spreadsheets</p> <p><u>Learning Objectives:</u></p> <ul style="list-style-type: none"> ● Describe the general process for modeling in MS-Excel spreadsheets. ● Describe some guidelines for building good spreadsheet models. ● Apply the general process for modeling in spreadsheets from a description of the problem. ● Identify deficiencies in poorly formulated spreadsheet models. ● Apply a variety of techniques for debugging spreadsheet models. 	Hillier & Hillier, Ch 4.1-4.4	<p>Finance (cash flow decisions; project selection decisions; investment decisions; pension fund design), marketing-operations interface (product-mix and production planning decisions), operations (aggregate production planning decisions; workforce scheduling decisions).</p> <p>Online assessment 12: “Spreadsheet engineering and models” (§4.1-4.4)</p>
26, 27	<p>Advanced Decision Modeling: Nonlinear Optimization</p> <p><u>Learning Objectives:</u></p> <ul style="list-style-type: none"> ● Describe the differences between nonlinear and linear decision models. 	Hillier & Hillier, Ch 8.1-8.2; 8.4-8.5	<p>Economics (profit modeling; decreasing marginal returns), finance (stock selection; portfolio selection; modern portfolio theory; international investment decisions), marketing-operations interface (product-mix decisions with nonlinear marketing costs and</p>

	<ul style="list-style-type: none"> ● Explain the difference between solving nonlinear optimization problems with (pre)calculus vs. with nonlinear (spreadsheet) decision models. ● Recognize when a nonlinear model is needed to represent a business decision. ● Formulate a nonlinear decision in MS-Excel model from a business problem description. ● Use MS-Excel's Nonlinear Solver to solve simple types of nonlinear decision problems. ● Distinguish between nonlinear problems that should be easy to solve and those that may be difficult (if not impossible) to solve. ● Use various techniques for difficult nonlinear decision models: multi-start, Evolutionary Solver. 		nonlinear profit functions), supply chain management (logistics routing decisions), marketing (advertising-mix decisions), government (state redistricting decisions). Project 2: Student decision model assignment
28	Course Wrap-up, Review		
FINAL	CUMULATIVE COMMON FINAL EXAM		

Course Methodology and Evaluation

The course is structured around a combination of class lectures, hand-on exercises on quantitative literacy, and individual and group assignments. Students are expected read the assigned readings in advance, submit the assignments on time, and actively participate in classroom. Overall class grades will be based on the following weights:

Deliverable	Weight
Online assessments (12 x 3% ea.)	36%
Projects (2 x 15% each)	30%
SAM/Excel Projects (3)	4%
Midterm exam	15%
Final exam	15%
TOTAL	100%

Online Assessments

Students will be expected to complete weekly online assessments. Assessments will either be conducted through a publisher's platform such as McGraw Hill Connect or through Blackboard.

Late submissions will not be accepted. For assignments requiring team work, you must contribute your fair share to receive full grade. Any disputes will be addressed on a case-by-case basis.

Projects

Students will complete two modeling projects that require them to use all that they've learned about multiple regression and decision modeling and then form a management decision. Emphasized in the project are (a) correct application of modeling techniques and (b) appropriate interpretation of the model results in words that are appropriate for your manager or client, and (c) clear, concise, and appropriate written managerial recommendations. Details of the project assignments and grading rubrics will be posted on Blackboard.

SAM/Excel Project

The Excel Project consists of 3 assignments to be completed using the SAM online platform. These projects are intended to improve your Excel skills and familiarize you with the spreadsheet skills needed in the 2nd half of the course. Successful completion of the 3 "SAM" assignments will constitute 4% of your final QNT 2020 grade. The assignments are graded using an automated process and you'll have 3 trials to complete each one of them. Only the best attempt of the three will count toward your grade. Please note: Each project is graded on a pass/fail basis:

- A score of 80% or better on any submission will earn you full credit for that project.
- Scores below 80% are equivalent to 0%, and no credit will be awarded for those submissions.

Full instructions are posted on Blackboard.

Exams

Exams will require hands-on work and will consist of multiple choice and/or problem-solving questions. All exams will cover material from all aspects of the class sessions (lectures, videos, in-class work, and so forth).

Attendance and Participation

Students are expected to attend all classes, read the assigned readings before the lectures, and participate actively in class sessions. Attendance and participation are important elements of the class.

Final letter grade

Letter grades are calculated according to the Official Grading System of Baruch College. The instructor reserves the right to curve the scale when computing final grades, if deemed necessary.

From (%)	To (%)	Letter Grade
0.0	59.9	F
60.0	67.0	D
67.1	69.9	D+

70.0	72.9	C-
73.0	77.0	C
77.1	79.9	C+
80.0	82.9	B-
83.0	87.0	B
87.1	89.9	B+
90.0	92.9	A-
93.0	100.0	A

General Course Policies

Exams

- In case of extraordinary circumstances, students who cannot attend an exam must contact the instructor *in advance* and provide a written justification/documentation for their absence.
- The final exam must be taken in the time slot posted in the college bulletin.
- The exams will include materials from both the readings and from the topics covered during our class sessions.
- Behavior during exams is expected to conform to Baruch College guidelines. Any form of cheating or communications with other students or any other incident of improper behavior will be dealt according to the guidelines established by the College.

Class Attendance

- To avoid disruption, you should arrive to the classroom on time and leave at the end of the class.
- Students should refrain from engaging in any kind of disruptive behavior during class. Disruptive behavior may result in penalties that will affect your final grade.

Work Submission Standards

- Assignments are considered *on time* only if they are submitted by the due date/time as per the submission guidelines.
- Hand-written work will be refused and will earn no credit unless otherwise instructed. As with any other academic submission, students must do their work carefully, striving to achieve high quality work. This includes writing clearly, checking the spelling and grammar, proofreading the submissions, and handing in the work on the specified due date.
- Extensions can be granted for situations involving illness, family, or personal emergencies. If you need an extension, you must request one via e-mail *before* the due date of an assignment when possible.

- For individual assignments or group projects, any instance of copying, cheating or plagiarism will be penalized and such instances will be reported to the Dean of students. Consequences may range from an F in the specific assignment to an F in the course.

Additional Notes

- Feel free to ask me why you received a certain grade on an assignment or exam. If you received a grade in error I will correct it. If not, and you still want to dispute the grade, I will consider re-grading requests but I will re-grade the entire assignment or exam. This could result in a grade that is the same, higher, or lower.
- Let me know about any problems or issues such as missing class, long term illnesses, job related problems, problems with the groups, etc. as soon as possible.

Students with disabilities

We have a process at Baruch for determining whether a student who identifies as disabled is eligible for reasonable accommodations in order to complete the student's academic program. We strive to ensure that no student with a disability is discriminated against and that none is denied participation in College programs and activities for lack of reasonable accommodations. Some people think that a disability has to be visible to be accommodated. This is not the case. There are many disabilities – diabetes, psychological illness, learning disabilities, AIDS, seizure disorders, arthritis, etc., – that require accommodations. Examples of possible accommodations include additional testing time; adaptive equipment; and taping of classes. If you feel that you may need a reasonable accommodation based on a disability, please contact the staff at the Office of Disability Services, Newman Vertical Campus, Room 2-271, or by phone at (646) 312-4590.

Academic Integrity Statement

The Zicklin School of Business fully supports Baruch College's policy on Academic Honesty, which states, in part: "Academic dishonesty is unacceptable and will not be tolerated. Cheating, forgery, plagiarism and collusion in dishonest acts undermine the college's educational mission and the students' personal and intellectual growth. Baruch students are expected to bear individual responsibility for their work, to learn the rules and definitions that underlie the practice of academic integrity, and to uphold its ideals. Ignorance of the rules is not an acceptable excuse for disobeying them. Any student who attempts to compromise or devalue the academic process will be sanctioned. "

Academic sanctions in this class will range from an F on the assignment to an F in this course. A report of suspected academic dishonesty will be sent to the Office of the Dean of Students. Additional information and definitions can be found at:

http://www.baruch.cuny.edu/academic/academic_honesty.html

Assurance of Learning

The BBA Program Learning Goals are embedded in the course to the following degrees:

- Analytical Skills: Students will possess the analytical and critical thinking skills to evaluate issues faced in business and professional careers.
- Technological Skills: Students will possess the necessary technological skills to analyze problems, develop solutions and convey information.
- Communication Skills (Oral): Students will have the necessary oral communication skills to convey ideas and information effectively and persuasively.
- Communication Skills (Written): Students will have the necessary written communication skills to convey ideas and information effectively and persuasively.
- Civic Awareness and Ethical Decision-making: Students will have the knowledge base and analytical skill to guide them when faced with ethical dilemmas in business. Students will have an awareness of political, civic and public policy issues affecting business.
- Global Awareness: Students will know how differences in perspectives and cultures affect business practices around the world.
- Proficiency in a Single Discipline: Students will possess a deep understanding of and intellectual competence in at least one business discipline.

BBA Learning Goals	Significant Part of Course	Moderate Part of Course	Minimal Part of Course	Not Part of Course
Analytical skills	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Technological skills	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oral communication skills	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Written communication skills	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Civic awareness and ethical decision-making	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Global awareness	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Course mapping with learning goals

<i>Course Learning Goals</i>	<i>BBA learning goals</i>	<i>Assignments</i>
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Use quantitative reasoning skills needed to interpret data and statistical analyses to solve business problems. ²	Analytical skills Technological skills Oral and written communication skills	Online assessments, projects, exams.
Design, build, and test quantitative models for business decision-making using spreadsheets and other technologies.	Analytical skills Technological skills	Online assessments, projects, SAM/Excel Project activities, exams
Employ statistical methods and multiple linear regression to analyze data and make predictions for business.	Analytical skills Technological skills Oral and written communication skills	Online assessments, projects, exams.
Interpret and communicate quantitative and statistical information in order to enable managerial decisions.	Analytical skills Technological skills Oral and written communication skills Global awareness Civic awareness and ethical decision-making	Projects, class discussions.

² See a definition of ‘quantitative literacy’ in Appendix I; also see general principles for achieving quantitative literacy in Appendix II.

**APPENDIX I:
How Course Supports Definition of Quantitative Literacy (QL)**

Category in Steen (2001)	Subcategory in Steen (2001)	Skill Enhanced in Decision Modeling Unit?	Skill Enhanced in Statistics & Multiple Regression Unit?
Confidence with Mathematics	Comfortable with quantitative ideas	X	X
	At ease applying quantitative methods	X	X
	Using mental estimates to quantify, interpret, and check other information.		
	Comfortable expressing mathematics in words	X	X
	Comfortable expressing mathematics in graphs		X
Cultural Appreciation	Understanding the nature and history of mathematics		
	Understanding the role of mathematics in scientific inquiry and technological progress		
	Understanding the importance of mathematics for comprehending issues in the public realm		X
Interpreting Data	Reasoning with data	X	X
	Reading graphs		X
	Drawing inferences		X
	Recognizing sources of error	X	X
Logical Thinking	Analyzing evidence		X
	Reasoning carefully	X	X
	Understanding arguments		X
	Questioning assumptions	X	X
	Detecting fallacies		X
	Evaluating risks		X
	Drawing logical conclusions, predictions or inferences	X	X
	Determining when it is valid to infer that one thing causes another		X
Making Decisions	Using mathematics to make decisions and solve problems in everyday life, the workplace, and within the wider society	X	
Mathematics in Context	Using mathematical models to express ideas	X	X
	Reading a body of text and expressing it in a mathematical framework	X	X

	Reading, understanding, interpreting and applying written technical material	X	X
	Understanding that notation, problem-solving strategies, and performance standards depend on the specific context	X	X
Number Sense	Accurate intuition about the meaning of numbers		
	Confidence in estimation		
	Common sense in employing numbers as a measure of things		
Practical Skills	Knowing how to solve quantitative problems likely encountered at home or at work.	X	
	Using elementary mathematics in a wide variety of common situations.		
Prerequisite Knowledge	Ability to use a wide range of algebraic, statistical and other mathematical tools that are required in an individual's field of study or professional work	X	X
Symbol Sense	Comfortable using algebraic symbols and equations	X	
	Comfortable reading and interpreting symbols and equations	X	X
	Exhibiting good sense about the syntax and grammar of mathematical symbols	X	X

Adapted from "[The Case for Quantitative Literacy](#)" by Lynn Arthur Steen, 2001, pp. 8-9.

APPENDIX II: General Principles for Achieving Quantitative Literacy

- Integration and reinforcement across the curriculum
 - Numbers and quantitative reasoning integrated into courses that are not primarily quantitative
- Fewer topics but greater depth of mastery
- Assignments and tests that require students to apply skills in applications that are meaningful to the students
 - Examples involving familiar concepts are more effective than examples which require extra learning.
 - Examples which motivate and interest students are valuable
- A variety of *different* applications
 - Increasing student role in framing the problem and in abstracting
- Excel exercises integrated into course content throughout the curriculum
- Rule of Four: All applications and concepts presented as:
 - Words
 - Numbers
 - Graphs
 - Symbols
 - Translate from any one to the other
- Practice
 - Interpreting and writing about numbers
 - Explaining equations in words
 - Reading, interpreting and applying technical writing
- Textbooks and other materials based on best-practice guidelines described
- A learning environment that emphasizes malleability-- the idea that people get smarter incrementally by working

From [Report of the Provost's Task Force on Quantitative Pedagogy](#), Baruch College, 2008.

APPENDIX III: Essential Competencies to Enter QNT 2020

1. Students are well-versed in the verbal, numerical, graphical, and symbolic representations of functions.
2. Students are able to interpret and analyze linear, quadratic, and other higher order polynomial functions, both graphically and algebraically.
3. Students can graph and solve systems of 2 equations and systems of 2 inequalities.
4. Students can interpret and form algebraic expressions using subscripted variables (e.g., x_1, x_2, \dots, x_n).

5. Students possess lower-intermediate MS-Excel spreadsheet skills including entering formulae, relative vs. absolute references, charts and graphs, basic Excel functions, basic worksheet formatting.
6. Students understand introductory business statistics concepts including descriptive statistics, the normal probability distribution, sampling distributions, hypothesis testing