MATH FOR DATA SCIENCE

SPS Certificate website: https://sps.northwestern.edu/post-baccalaureate/math-data-science/index.php (https://sps.northwestern.edu/post-baccalaureate/math-data-science/)

For students and professionals seeking to build math and analysis proficiency, the Math for Data Science post-baccalaureate certificate program is designed to strengthen their quantitative background for graduate school or to enhance their data analysis skills for their careers. Consisting of courses in applied mathematics, statistics, and calculus, the program provides students with a quantitative foundation for data analysis—a critical skillset that is applicable to a wide range of industries.

Certificate Offered

- Math for Data Science, Certificate (https://catalogs.northwestern.edu/sps/certificates/post-baccalaureate/math-data-science/math-data-science-certificate/)

Math for Data Science Courses

MATH 100-CN Quantitative Reasoning (1 Unit)
NPEP course.

MATH 101-CN Algebra (1 Unit)
Overview of core mathematical concepts that permeate business, science and everyday life. Primary focus is on mathematical tools needed in a variety of degree programs. Topics include: functions and graphs, linear, polynomial and rational equations, inequalities and their applications, modeling, variation, and systems of equations. This course does not count for credit if taken after any higher mathematics course. May not be audited.

MATH 101-DL Algebra (1 Unit)
Overview of core mathematical concepts that permeate business, science and everyday life. Primary focus is on mathematical tools needed in a variety of degree programs. Topics include: functions and graphs, linear, polynomial and rational equations, inequalities and their applications, modeling, variation, and systems of equations. This course does not count for credit if taken after any higher mathematics course. May not be audited.

MATH 110-CN Introduction to Mathematics (1 Unit)
NPEP course.

MATH 113-CN Precalculus Mathematics (1 Unit)
Properties and graphs of the basic functions: polynomial, rational, exponential, logarithmic, and trigonometric. Complex numbers, theory of equations, and selected topics are also included. May not be audited.

MATH 202-CN Finite Mathematics (1 Unit)
Foundation of mathematical knowledge targeting data analysis. Topics chosen from set theory, combinatorics (the art of counting), finite probability, elementary linear algebra and its applications to linear optimization problems.

MATH 211-CN Short Course in Calculus (1 Unit)
Elements of differential and integral calculus.

MATH 220-A Single-Variable Differential Calculus (1 Unit)
Limits. Differentiation. Linear approximation and related rates. Extreme value theorem, mean value theorem, and curve-sketching. Optimization.

MATH 220-B Single-Variable Integral Calculus (1 Unit)
Definite integrals, antiderivatives, and the fundamental theorem of calculus. Transcendental and inverse functions. Areas and volumes. Techniques of integration, numerical integration, and improper integrals. First-order linear and separable ordinary differential equations.
Prerequisite: MATH 220-A.

MATH 226-CN Sequences and Series (1 Unit)
Sequences, series, and convergence tests. Power series, Taylor polynomials and error. Complex numbers. Second-order linear ordinary differential equations and power series solutions.
Prerequisite: MATH 220-B.

MATH 230-A Multivariable Differential Calculus (1 Unit)
Vectors, vector functions, partial derivatives, and optimization.
Prerequisite: MATH 220-B.

MATH 230-B Multivariable Integral Calculus (1 Unit)
Multiple integration: double integrals, triple integrals, and the change of variables theorem. Vector calculus: vector fields, line integrals, surface integrals, curl and divergence, Green's theorem, Stokes' theorem, and the divergence theorem.
Prerequisite: MATH 230-A.

MATH 240-CN Linear Algebra (1 Unit)
Elementary linear algebra: systems of linear equations, matrix algebra, subspaces, determinants, eigenvalues, eigenvectors, and orthogonality.
Prerequisite: MATH 230-A or equivalent.

MATH 250-CN Elementary Differential Equations (1 Unit)
Elementary ordinary differential equations: first-order equations, second-order linear equations, series solutions, and systems of first-order linear equations.
Prerequisite: MATH 230-A, MATH 240-CN, or equivalents.

MATH 300-CN Foundations of Higher Mathematics (1 Unit)
Introduction to fundamental mathematical structures, including sets, functions, equivalence relations, and cardinal numbers. Elementary logic and proof techniques.
Prerequisite: MATH 240-CN.

MATH 306-CN Combinatorics & Discrete Mathematics (1 Unit)
Discrete mathematics, inductive reasoning, counting problems, binomial coefficients and Pascal's triangle, Fibonacci numbers, combinatorial probability, divisibility and primes, partitions, and generating functions.
Prerequisite: MATH 240-CN.

MATH 310-A Probability and Stochastic Processes (1 Unit)
Axioms of probability. Conditional probability and independence. Random variables. Joint distributions. Expectation. Limit theorems: the weak law of large numbers and the central limit theorem.
Prerequisite: MATH 230-B.

MATH 310-B Probability and Stochastic Processes (1 Unit)
Discrete-time Markov chains, recurrence and transience.
Prerequisite: MATH 240-CN and MATH 310-A.

MATH 310-C Probability and Stochastic Processes (1 Unit)
Continuous-time Markov chains, queues, population growth models. Brownian motion and other diffusion processes.
Prerequisite: MATH 310-B.

MATH 320-A Introduction to Real Analysis (1 Unit)
Analysis on the real line: axiomatic development of the real number system, sequences and series of real numbers, continuity, and differentiability.
Prerequisite: MATH 300-CN.

MATH 320-B Real Analysis II (1 Unit)
Analysis on the real line: the Riemann integral and sequences and series of functions.
Prerequisite: MATH 320-A.

MATH 320-C Introduction to Real Analysis (1 Unit)
Analysis on Euclidean spaces: the topology of Euclidean spaces, limits, continuity, and differentiability, including the inverse and implicit function theorems.
Prerequisite: MATH 320-B.

MATH 325-CN Complex Analysis (1 Unit)
Complex numbers. Analytic functions. Cauchy's theorem and the Cauchy integral formula. Series. Residues.
Prerequisite: MATH 230-B.

MATH 330-A Abstract Algebra (1 Unit)
Group theory.
Prerequisite: MATH 300-CN.

MATH 334-CN Linear Algebra II: Second Course (1 Unit)
Vector spaces. Linear maps. Eigenvalues, eigenvectors and invariant subspaces. Inner product spaces. Canonical forms of operators on real and complex vector spaces.
Prerequisite: MATH 300-CN.

MATH 336-A Introduction to the Theory of Numbers (1 Unit)
Divisibility and prime numbers. Congruences. Quadratic reciprocity. Diophantine equations.
Prerequisite: MATH 230-A.

MATH 340-CN Geometry (1 Unit)
Axioms for Euclidean geometry. Non-Euclidean geometry. Projective geometry. Introduction of coordinate systems from the axioms. Quadrics. Erlangen program. Introduction to plane algebraic curves.
Prerequisite: MATH 300-CN.

MATH 366-A Mathematical Models in Finance (1 Unit)
Cash flow computations. Basic financial concepts (stocks, bonds, options, arbitrage, hedging) and put-call parity. Binomial tree models. Risk-neutral valuation. Random walk and Brownian motion as a tool of modeling fluctuations. Options pricing. Applications of the central limit theorem. The Black-Scholes formula and partial differential equation. Numerical approximations. Some familiarity with differential equations is desirable.
Prerequisite: MATH 240-CN.

MATH 399-CN Independent Study (1 Unit)