Descriptive Coursework List: Tachyoung Kim

B.S. in Department of Statistics and Mathematical Sciences, March 2020 – June 2026

**Military Leave of Absence, March 2022 – December 2023*

Fall 2025

- Probability Theory 2
- Advanced Statistical Computing
- Stochastic Differential Equations
- Undergraduate Independent Research: Inquiry

Spring 2025

- Nonparametric Function Estimation
- Analysis 1
- Topics in Applied Mathematics
- Measure Theory and Probability

Fall 2024

- Mathematical Statistics 2
- Deep Learning: Statistical Perspective
- Multivariate Data Analysis and Lab.
- Bayesian Statistics and Lab.
- Numerical Linear Algebra
- Physics Lab.2

Spring 2024

- Regression Analysis and Lab.
- Mathematical Statistics 1
- Mathematical Foundations of Deep Neural Networks
- Experimental Design and Lab.
- Introduction to Numerical Analysis
- Chemistry Lab.

Fall 2021

- Introduction to Mathematical Analysis 2
- Linear Algebra 2
- Sampling Design and Survey Practice
- Discrete Mathematics

Spring 2021

- Concepts and Applications in Probability
- Introduction to Mathematical Analysis with Practice 1
- Linear Algebra 1
- Differential Equations
- College Writing 2: Writing in Science & Technology
- Chemistry

Fall 2020

- Statistical Computing and Lab.
- Differential and Integral Calculus and Practice 2
- Physics 2

Spring 2020

- Statistics and Lab
- Differential and Integral Calculus and Practice 1
- Physics and Lab.1

Fall 2025

Probability Theory 2

Course Information	326.516 001, Statistics, Graduate
Instructor	Jisu Kim
References	Rick Durrett, *Probability: Theory and Examples* (5th Edition), Cambridge University Press, 2019
Subject Matter	Conditional probability of random variables and martingale theories, convergence theorems, inequalities, decompositions, optional sampling theorems, central limit theorems, uniform integrability, infinitely divisible distributions.

Advanced Statistical Computing

Course Information	M1399.000200 001, Statistics, Graduate
Instructor	Joongho Won
References	Kenneth Lange, *MM Optimization Algorithms*, 2nd ed. (manuscript); 1st ed. SIAM (2016).
Subject Matter	Nonsmooth analysis, Fenchel conjugates and subdifferentials, Majorization–Minimization, proximal algorithms, regression and multivariate analysis, convergence and acceleration.

Stochastic Differential Equations

Course Information	M1407.002600 001, Mathematics, Advanced Undergraduate (Year 3)
Instructor	Panki Kim
References	Introduction to Brownian motion, stochastic integration, SDEs
Subject Matter	continuous-time martingales, Itô integrals, square-integrable martingales and quadratic variation, local martingales and semimartingale integrators, Itô formula, representation theorem, Girsanov theorem, Markov/strong Markov processes, diffusion processes, infinitesimal generators, existence and uniqueness (strong/weak), Feynman–Kac formula, strong Markov property of solutions.

Undergraduate Independent Research: Inquiry

Course Information	E31.103 009, College, Undergraduate (Year 1)
Advisor	Jisu Kim
Subject Matter	Subsampling Confidence Bound for Persistent Diagram via Time-delay Embedding.

Spring 2025

Nonparametric Function Estimation

Course Information	326.626A 001, Statistics, Graduate
Instructor	Byeonguk Park
Grade	A0
References	Instructor's Notes
Subject Matter	Kernel-based methods for density, mean regression and quantile regression; smoothing via Nadaraya–Watson, local polynomials, quasi-likelihood; spline approaches (regression, penalized, smoothing); additive and partially linear models.

Topics in Applied Mathematics

Course Information	3341.751 002, Mathematical Sciences, Graduate, in English
Instructor	Ernest Ryu
Grade	A+
References	Instructor's Notes
Subject Matter	MDPs; Policy Evaluation; Imitation & Deep RL (Policy Gradients, DQN); Symmetric Markov Games; MCTS & AlphaGo; Imperfect-Information Games; NLP architectures (RNNs, Transformers, Encoder–Decoder); Instruction Tuning; Scaling Laws; RLHF & Direct Policy Optimization (GRPO); Chain-of-Thought & Process Rewards; Prover–Verifier Games; In-Context Learning; Test-Time Scaling (e.g., DeepSeek-R1).

Analysis 1

Course Information	M1407.002000 001, Mathematical Sciences, Graduate
Instructor	Kihyun Kim
Grade	A+
References	Elias M. Stein and Rami Shakarchi, *Real Analysis: Measure Theory, Integration, and Hilbert Spaces*, Princeton University Press, 2008
Subject Matter	Lebesgue measure and integration on Euclidean space; product measure and Fubini; complex measures and the Radon–Nikodym theorem; Lebesgue decomposition; measures on topological spaces; Riesz representation theorem.

Measure Theory and Probability

Course Information	M1407.002500 001, Mathematical Sciences, Advanced Undergraduate (Year 3)
Instructor	Panki Kim
Grade	A+
References	David Williams, *Probability with Martingales*, Cambridge University Press (1991)
Subject Matter	Measure-theoretic probability; integration and expectation; conditional expectation; convergence theorems; stopping times; martingales and submartingales; optional stopping; Doob decomposition.

Fall 2024

Mathematical Statistics 2

Course Information	326.312 001, Statistics, Advanced Undergraduate (Year 3)
Instructor	Johan Lim
Grade	A+
References	Woochul Kim, *Mathematical Statistics* (Korean)
Subject Matter	Estimation (method of moments, MLE, MVUE); hypothesis testing (LR, Rao, Wald, UMP); sufficiency; Rao–Blackwell; Cramér–Rao; asymptotics.

Deep Learning: Statistical Perspective

Course Information	M1399.000400 001, Statistics, Graduate
Instructor	Jisu Kim
Grade	A+
References	Instructor's Notes
Subject Matter	Statistical foundations of deep learning, neural network theory, training dynamics, generalization, generative models (GANs, diffusion), neural tangent kernels, large language models.

Multivariate Data Analysis and Lab.

Course Information	326.316 001, Statistics, Advanced Undergraduate (Year 3)
Instructor	Gunwoong Park
Grade	A0
References	R.A. Johnson and D. Wichern, *Applied Multivariate Statistical Analysis*
Subject Matter	Multivariate distributions; hypothesis testing; PCA; factor analysis; classification; applications.

Bayesian Statistics and Lab.

Course Information	326.411 001, Statistics, Advanced Undergraduate (Year 4)
Instructor	Jaeyong Lee
Grade	A+
References	Jaeyong Lee and Gijae Lee, *Bayesian Data Analysis* (Korean)
Subject Matter	Bayesian inference and computation: priors, decision theory, Monte Carlo, importance sampling, asymptotic posterior analysis, Laplace approximation, MCMC (Gibbs, MH, HMC), hierarchical modeling, model selection, diagnostics, Stan.

Numerical Linear Algebra

Course Information	881.319 001, Mathematical Sciences, Advanced Undergraduate (Year 3)
Instructor	Myungjoo Kang
Grade	A+
References	William Ford, *Numerical Linear Algebra with Applications: Using MATLAB* (Elsevier, 2015)
Subject Matter	Matrix analysis; direct/iterative solvers; eigenvalue and singular value problems; LU/QR/Cholesky/SVD; least squares; conditioning and stability; implementations (Python/MATLAB).

Physics Lab.2

Course Information	034.010 053, Physics, Undergraduate (Year 1)
Instructor	Chulhwan Park
Grade	S
Subject Matter	Continuation of Physics Lab 1; experiments in electricity and magnetism, light, special relativity, and quantum phenomena.

Spring 2024

Regression Analysis and Lab.

Course Information	326.313 001, Statistics, Advanced Undergraduate (Year 3)
Instructor	Byeonguk Park
Grade	A0
References	Instructor's Notes
Subject Matter	Simple/multiple regression; diagnostics; model adequacy; transformations; polynomial and nonparametric regression; indicator variables and multicollinearity; variable selection; GLMs; artificial neural networks.

Mathematical Foundations of Deep Neural Networks

Course Information	M1407.001200 001, Mathematical Sciences, Advanced Undergraduate (Year 3), in English
Instructor	Ernest Ryu
Grade	A+
References	Instructor's Notes
Subject Matter	Optimization and SGD; architectures (MLP, CNNs, VGG, ResNet); regularization and normalization; advanced models (Flow, VAE, GAN); applications to vision and inverse problems.

Mathematical Statistics 1

Course Information	326.311 001, Statistics, Advanced Undergraduate (Year 3)
Instructor	Jaeyong Lee
Grade	A-
References	Woochul Kim, *Mathematical Statistics* (Korean)
Subject Matter	Probability foundations; distributions (binomial, Poisson, gamma, normal, uniform, t, F); expectation and inequalities; joint/conditional distributions; independence; transformations; sampling; order statistics; multivariate normal; convergence; CLT; limit distributions.

Experimental Design and Lab.

Course Information	326.315 001, Statistics, Advanced Undergraduate (Year 3)
Instructor	Johan Lim
Grade	A+
References	Sunghyun Park, *Experimental Design* (Korean)
Subject Matter	Completely randomized design; Latin square; factorial and fractional factorial; block designs; response surface methodology; analysis of designed experiments.

Introduction to Numerical Analysis

Course Information	881.320 001, Mathematical Sciences, Advanced Undergraduate (Year 3)
Instructor	Myungjoo Kang
Grade	A+
References	Ward Cheney & David Kincaid, *Numerical Mathematics and Computing*, 7th ed. (2013)
Subject Matter	Error analysis; interpolation (polynomial/trigonometric); FFT; splines; numerical integration; Peano form; Euler–Maclaurin; Gauss quadrature; Newton & quasi-Newton; polynomial roots.

Chemistry Lab.

Course Information	034.024 030, Chemistry, Undergraduate (Year 1)
Instructor	Seunghoon Lee
Grade	A0
References	*Chemistry Laboratory* by Heejun Kim
Subject Matter	Hands-on experiments to deepen understanding of chemical concepts.

Fall 2021

Introduction to Mathematical Analysis 2

Course Information	3341.202 003, Mathematical Sciences, Undergraduate (Year 2)
Instructor	Minhee Kim
Grade	A-
References	*Introduction to Mathematical Analysis* by Kim, Kim and Kye (Korean)
Subject Matter	Sequences and series of functions; power and trigonometric series; function spaces; improper integrals; integrals-defined functions; Gamma function; integral transforms; Fourier series with convergence, differentiation, and integration properties.

Linear Algebra 2

Course Information	300.206A 002, Mathematical Sciences, Undergraduate (Year 2)
Instructor	Dongho Byeon
Grade	A-
References	Insok Lee, *Linear Algebra and Groups* (Korean)
Subject Matter	Rigid motion; inner product spaces; groups; quotient spaces; triangularization; bilinear and Hermitian forms; spectral theorem.

Sampling Design and Survey Practice

Course Information	326.214 001, Statistics, Undergraduate (Year 2)
Instructor	Heeseok Oh
Grade	A-
References	Scheaffer, Mendenhall, Ott and Gerow, *Survey Sampling*, 7th ed. (Cengage, 2011)
Subject Matter	Simple random, stratified, systematic, cluster, two-stage cluster sampling; ratio and regression estimation; other sampling methods.

Discrete Mathematics

Course Information	4190.101 001, Computer Science and Engineering, Undergraduate (Year 1), in English
Instructor	Yongsoo Song
Grade	A+
References	Kenneth H. Rosen, *Discrete Mathematics and Its Applications*, 8th ed., McGraw-Hill, 2019
Subject Matter	Logic, sets, functions, relations, countability, combinatorics, proof techniques, induction, recursion, recurrences, graph theory, number theory.

Spring 2021

Concepts and Applications in Probability

Course Information	326.211 001, Statistics, Undergraduate (Year 2)
Instructor	Joongho Won
Grade	A0
References	Sheldon M. Ross, *A First Course in Probability*, 10th ed., Pearson, 2018
Subject Matter	Set theory; probability models; discrete/continuous random variables; joint distributions; expectation; LLN; CLT; applications.

Introduction to Mathematical Analysis with Practice 1

Course Information	M1407.000600 003, Mathematical Sciences, Undergraduate (Year 2)
Instructor	Hyunsuk Choi
Grade	B+
References	*Introduction to Mathematical Analysis* by Kim, Kim and Kye (Korean)
Subject Matter	Real numbers and completeness; sequence limits and monotone sequences; countable/open sets; bounded/Cauchy sequences; series convergence; compact/connected sets; continuity and uniform continuity; differentiable functions; Riemann and Riemann–Stieltjes integrals; functions of bounded variation; sequences of continuous/differentiable/integrable functions.

Linear Algebra 1

Course Information	300.203A 002, Mathematical Sciences, Undergraduate (Year 2)
Instructor	Dongho Byeon
Grade	A0
References	Insok Lee, *Linear Algebra and Groups* (Korean)
Subject Matter	Matrices and Gaussian elimination; vector spaces; bases and dimension; linear transformations; fundamental theorems; determinants; characteristic polynomials; diagonalization; decomposition theorems.

Differential Equations

Course Information	881.003 002, Mathematical Sciences, Undergraduate (Year 2)
Instructor	Jaehui Park
Grade	A+
References	Boyce, DiPrima, Meade, *Elementary Differential Equations and Boundary Value Problems* (Wiley, 2017)
Subject Matter	First/second/higher-order linear ODEs; series solutions; Laplace transform; systems; nonlinear dynamics and stability; PDEs and Fourier series; Sturm–Liouville theory.

College Writing 2: Writing in Science & Technology

Course Information	L0440.000900 014, Faculty of Liberal Education, Undergraduate (Year 1)
Instructor	Jaeho Kim
Grade	A0
References	Instructor's Notes
Subject Matter	Scientific/technical writing; logical and critical thinking; organization and persuasive exposition.

Chemistry

Course Information	034.020 001, Chemistry, Undergraduate (Year 1)
Instructor	Woonju Song
Grade	A0
References	P. Atkins and L. Jones, *Chemical Principles* (Freeman)
Subject Matter	Atoms; quantum; bonding; molecular shape/structure; thermodynamics and free energy; equilibria; acids/bases; electrochemistry; kinetics.

Fall 2020

Statistical Computing and Lab.

Course Information	326.212 001, Statistics, Undergraduate (Year 1)
Instructor	Joongho Won
Grade	A-
References	Hadley Wickham et al., *R for Data Science* (O'Reilly, 2017)
Subject Matter	R programming; tidyverse; visualization; EDA; relational/text data; date/time; functional programming; iteration; model building; capstone project.

Differential and Integral Calculus and Practice 2

Course Information	L0442.001100 001 / L0442.001200 003, Mathematical Sciences, Undergraduate (Year 1)
Instructor	Seonhee Lim
Grade	A0 / A+
References	*Calculus 2+* (Korean)
Subject Matter	Multivariable calculus and vector analysis; partial derivatives; optimization (Hessian, Lagrange multipliers); Jacobians; vector fields; line/surface integrals; multiple integrals; Green, Gauss, Stokes theorems.

Physics 2

Course Information	034.002 002, Physics, Undergraduate (Year 1)
Instructor	Seonho Choi
Grade	A-
References	Halliday, Resnick, Walker, *Fundamentals of Physics* (10th ed.)
Subject Matter	Electricity and magnetism; AC/RLC; Maxwell equations; EM waves; optics; special relativity; quantum effects; atomic/nuclear structure; cosmology.

Spring 2020

Statistics and Lab

Course Information	033.019 001 / 033.020 001
Instructor	Sungkyu Jung
Grade	A- / A+
References	Diez, Barr, Çetinkaya-Rundel, *OpenIntro Statistics*, 3rd ed., 2015
Subject Matter	Data collection and exploration; graphical/numerical summaries; probability and random variables; sampling distributions; confidence intervals; hypothesis testing (single mean/proportion); regression intro.

Differential and Integral Calculus and Practice 1

Course Information	L0442.000900 001 / L0442.001000 004
Instructor	Dohyoung Kim
Grade	A0 / A+
References	*Calculus 1+* (Korean)
Subject Matter	Series and Taylor expansions; vectors and matrices; curves; convergence tests; power and Taylor series; coordinate systems; parametric/polar curves; arc length; curvature; line integrals; physical applications (motion, center of mass).

Physics and Lab.1

Course Information	034.001 002 / 034.009 042, Physics, Undergraduate (Year 1)
Instructor	Seonho Choi
Grade	A+ / A0
References	Halliday, Resnick, Walker, *Fundamentals of Physics* (10th ed.)
Subject Matter	Mechanics; waves; thermodynamics; motion; forces; energy; momentum; rotation; fluids; oscillations; sound; laws of thermodynamics.