Courses Description

Analysis I
 ◦ Instructor : Prof. Changkeun Oh
 ◦ Textbook : Stein, E. M. (2005) Real Analysis: Measure Theory, Integration, and Hilbert Spaces. Princeton Lectures in Analysis. Princeton University Press. ISBN 9780691113869.
 ◦ Description : This course discusses such topics as Lebesgue measure and integration of Euclidean space, product measure and the Fubini theorem, complex measure and the Radon-Nykodim theorem, Lebesgue decomposition, measure of topological spaces and the Riesz representation theorem.

Mathematical Statistics I
 ◦ Instructor : Prof. Jaeyong Lee
 ◦ Textbook : Kim, W. (2012) Mathematical Statistics. Minyoung Press. ISBN 9788981341350.
 ◦ Description : This course introduces the definition of probability and the concepts of distribution functions and probability density functions, which are fundamental to statistics. The topics include various types of distribution functions and their properties, the concept of a sampling distribution, the distribution of statistic, various properties of sampling distributions and approximations to sampling distributions.

Mathematical Statistics II
 ◦ Instructor : Prof. Junyong Park
 ◦ Textbook : Kim, W. (2012) Mathematical Statistics. Minyoung Press. ISBN 9788981341350.
 ◦ Description : The topics include statistical inference, hypothesis testing, comparison of estimators, comparison of tests, analysis of variance, and regression analysis. The goal is to achieve a correct understanding and application of statistical methodologies by comprehending the theoretical properties of these topics.

Mathematical Machine Learning Theory
 ◦ Instructor : Prof. Ernest Ryu
 ◦ Textbook : Bach, F. (2023) Learning Theory from First Principles. MIT Press. ISBN 9780262049443. & Mohri, M., Rostamizadeh, A. & Talwalkar, A. (2018) Foundations of Machine Learning, 2nd ed. MIT Press. ISBN 9780262039406.
 ◦ Description : This course focuses on understanding the mathematical theory behind machine learning algorithms and aims to use mathematical reasoning to design better machine learning methods. The topics include reproducing kernel Hilbert spaces and kernel methods, gradient descent, Rademacher complexity, Newton's method, stochastic gradient descent, and continuous-time models of gradient descent.

Causal Inference
  ◦ Instructor : Prof. Kwonsang Lee
  ◦ Textbook : Rosenbaum, P. R. (2020) Design of Observational Studies, 2nd ed. Springer. ISBN 9783030482616. & Rosenbaum, P. R. (2002) Observational Studies, 2nd ed. Springer. ISBN 9781441931811.
  ◦ Description : This course introduces statistical theory and methods of causal inference with applications in various scientific fields. Topics will include potential outcomes; randomized experiments; confounding; observational studies; matching; weighting; propensity score methods; doubly robust; unmeasured confounding bias; sensitivity analysis; instrumental variables; quasi-experimental designs.

Regression Analysis and Lab.
  ◦ Instructor : Prof. Taesung Park
  ◦ Textbook : Montogomery, D. C., Peck, E. A. & Vincing, G. G. (2012) Introduction to Linear Regression Analysis. John Wiley & Sons. ISBN 9780470542811.
  ◦ Description : This course covers important topics in regression analysis. The topics include simple and multiple regression analysis, residual analysis, polynomial regression analysis, variable and model selection, logistic regression analysis, and generalized linear models.

Multivariate Data Analysis and Lab.
  ◦ Instructor : Prof. Sungkyu Jung
  ◦ Textbook : Johnson, R. A. & Winchern, D. W. (2002) Applied Multivariate Statistical Analysis. Prentice Hall. ISBN 9780130925534.
  ◦ Description : This course covers the fundamentals of multivariate data analysis, including distribution theories related to multivariate normal distribution, principal component analysis, factor analysis, classification and discriminant analysis, canonical correlation analysis, and cluster analysis.

Nonparametric Statistics and Lab.
  ◦ Instructor : Prof. Kwonsang Lee
  ◦ Textbook : Higgins, J. J. (2004) Introduction to Modern Nonparametric Statistics. Brooks/Cole. ISBN 9780534387754.
  ◦ Description : This elementary course introduces basic nonparametric methods and distribution-free statistics. It also deals with distributions of order and rank statistics. Some of the specific issues that are dealt with include nonparametric estimation of point and confidence intervals with comparison of parametric methods, location parameter estimation of one sample, location and scale parameter estimation of two samples, and nonparametric testing problem of distribution functions.

Survival Data Analysis and Lab.
  ◦ Instructor : Prof. Myunghee Cho Paik
  ◦ Textbook : Klein, J. P. & Moeschberger, M. L. (2003) Survival Analysis, 2nd ed. Springer. ISBN 9780387953991.
  ◦ Description : This course introduces the estimation and testing of survival time and be introduced to the life table method and Kaplan-Meyer estimation to model survival functions. The topics include various test methods for the comparison of three or more groups as well as regression models such as Cox proportional hazard models and accelerated regression models for the selection of risk factors that affect survival time.

Data Mining Methods and Lab.
  ◦ Instructor : Prof. Taesung Park
  ◦ Textbook : James, G., Witten, D., Hastie, T. & Tibshirani, R. (2017) An Introduction to Statistical Learning: with Applications in R, 1st ed., Corr. 7th printing. Springer Texts in Statistics. ISBN 9781461471370.
  ◦ Description : This course introduces students to diverse data analysis methodologies and provides them with opportunities to apply these techniques. The topics include information retrieval, dimension reduction, penalized regression, model selection and validation, classification, clustering, ensemble methods, and how to choose appropriate data analysis methods to address specific problems or objectives.

Experimental Design and Lab.
  ◦ Instructor : Prof. Heeseok Oh
  ◦ Textbook : Montgomery, D. C. (2013) Design and Analysis of Experiments, 8th ed. Wiley. ISBN 9781118146927.
  ◦ Description : This course introduces several effective methods to collect and analyze data to improve processes, reduce costs, and understand a complex system for both scientific research and industrial applications. The course covers complete randomized design, Latin square design, factorial design, block design, fractional factorial design, response surface analysis, and how to analyze data collected according to each design method.

Linear Algebra 1
  ◦ Instructor : Prof. Dongho Byeon
  ◦ Textbook : Lee, I. (2015) Linear Algebra and Group Theory. Seoul National University Press. ISBN 9788952117441.
  ◦ Description : This course introduces fundamental concepts of linear algebra, including Gaussian elimination, row-reduced echelon form, matrices, linear maps, and determinants. The course covers vector spaces, including basis and dimension, as well as the matrix representation of linear maps under basis changes. Topics also include characteristic polynomials, diagonalization, triangularization, inner product spaces, and bilinear forms. Additionally, the course explores elementary group theory to define orthogonal groups,

focusing on the structures of 2-dimensional and 3-dimensional orthogonal groups. Quotient spaces are also introduced to facilitate induction on dimension.

Concepts and Applications in Probability
- ◦ Instructor : Prof. Joong-Ho Won
- ◦ Textbook : Ross, S. M. (2012) A First Course in Probability, 9th ed. Pearson. ISBN 9780321794772.
- ◦ Description : This course introduces the fundamental concepts of probability theory, highlighting its applications across natural sciences, engineering, and social sciences. Topics include basic probability principles, probabilistic thinking, and mathematical techniques essential for understanding phenomena in modern society. The course emphasizes the role of probability in computer science, including applications in artificial intelligence and computer communication, providing students with a broad perspective on probabilistic methods used to analyze complex systems.

Differential Equations
- ◦ Instructor : Prof. Mee Yoon
- ◦ Textbook : Boyce, W. E. & DiPrima, R. C. (2017) Elementary Differential Equations and Boundary Value Problems, 11th ed. Wiley. ISBN 9781119443636.
- ◦ Description : This course introduces methods of solving ordinary differential equations, series methods, Laplace transform methods, theorems on existence and uniqueness theorems.

Statistical Computing and Lab.
- ◦ Instructor : Prof. Joong-Ho Won
- ◦ Textbook : No textbook.
- ◦ Description : This course introduces the fundamental concepts of computer programming for modern statistical analysis, focusing on the use of complex statistical models enabled by recent advances in computer technology. Students will learn the basics of statistical data analysis using the R programming language, gaining hands-on experience in applying these techniques to analyze data effectively.