Statistical Science

Course Code	Course	Credit	Content of Subject
40STS001**	Introduction to Time Series and Spatial Modeling	2	This course introduces the foundations of time series analysis, point process, and spatial/spatio-temporal modeling. Emphasis is placed on statistical modeling and model selection by information criteria. ※Students who have already taken "Introduction to Statistical Modeling Ⅰ (10SMS001)", "Introduction to Statistical Modeling Ⅱ (10SMS002)" can't take this course.
40STS002**	Introduction to Multivariate Analysis	2	This course deals with a wide range of techniques (regression analysis, discriminant analysis, principal component analysis, factor analysis, covariance structure analysis, etc.) for analyzing multivariate data. ※Students who have already taken " Introduction to Statistical Data Science Ⅰ (10SMS003)" "Introduction to Statistical Data Science Ⅱ (10SMS004)" can't take this subject.
40STS003**	Introduction to Probability and Stochastic Processes	2	The lectures in this subject explore fundamental concepts relating to theories of probability and stochastic processes. More specifically, the subject covers probability space, random variable, convergence, generating and characteristic functions, Poisson process, and Markov chain. ※Students who have already taken "Introduction to Statistical Inference Ⅰ (10SMS005)" can't take this subject.
40STS004**	Introduction to Mathematical Statistics	2	This lecture course provides an overview of the theory of mathematical statistics. The main topic of the course is the theory of statistical inference. Specifically, the course deals with summary statistics, sampling distributions, point estimation, interval estimation, hypothesis testing and regression models. Applications of the theory of mathematical statistics to real problems are also discussed. ※Students who have already taken "Introduction to Statistical Inference Ⅱ (10SMS006)" can't take this subject.

Statistical Science

Course Code	Course	Credit	Content of Subject
40STS005**	Introduction to Computational Mathematics	2	The course covers fundamentals of computational mathematics such as matrix differential calculus, numerical linear algebra, linear programming, integer programming, dynamic programming, optimization theory, optimization methods, conic programming, and combinatorial optimization.
40STS006**	Introduction to Statistical Machine Learning	2	The lectures discuss methods and theory of statistical machine learning including support vector machines, deep learning, Gaussian processes, ensemble learning, transfer learning, reinforcement learning, and statistical learning theory. ※Students who have already taken "Computational Methodology in Statistical Ⅱ (10SMS008)" can't take this subject.
40STS007**	Introduction to Computational Inference	2	This course deals with methodologies in computational statistics with their applications in statistics and machine learning. Topics include nonparametric bootstrap, Markov chain Monte Carlo, particle filter, graphical modeling and belief propagation, EM algorithm, and variational Bayesian inference. ※Students who have already taken "Computational Methodology in Statistical Ⅱ (10SMS008)" can't take this subject.
40STS008**	Special Topics in Statistical Modeling	2	The course will discuss the basics of the inference for un-normalized models and sparse modeling and its applications. Also, methodologies of formulating problems into "solvable" forms for various real-world problems are discussed.
40STS009**	Complex Systems Analysis	2	The lecture will discuss deterministic and probabilistic approaches to time series data analysis and modeling. In addition, students take turns reading books and papers about detecting significant signals, spatial correlations, and causality in time series data.
40STS010**	Special Topics in Modeling 1	2	Shannon's information theory is lectured as a basic theory for analysis of information sources. The amount of information, entropy, and communication sysytems are discussed. And actual radio communication systems are lectured. (Not offered in AY 2026)

Statistical Science

Course Code	Course	Credit	Content of Subject
40STS011**	Special Topics in Modeling 2	2	This course deals with advanced computational statistics with their applications. Examples are specialized topics in Markov Chain Monte Carlo, sequential Monte Carlo, bootstrap, and their applications in Bayesian statistics and model selection. (Not offered in AY 2026)
40STS012**	Special Topics in Time Series Analysis	2	After covering the basics of stationary time series models that were not fully covered in Introduction to Time Series and Spatial Modeling, causality analysis based on multivariate autoregressive (VAR) models, impulse responses, etc. will be covered. After introducing unit root tests, we will expand our understanding to cointegration models. With financial time series (rate of return data) in mind, the conditional heteroscedasticity models will be outlined. In addition, time-varying variance modeling will be discussed in relation to local stationary AR models and non-Gaussian filters. Computer exercises using R or R Shiny applications will be conducted once after every two or three lectures.
40STS013**	Stochastic Modeling	2	This course provides an introduction to stochastic processes, with their applications to real-world situations. This course covers elementary stochastic processes such as Gaussian, Poisson, Markov and renewal processes.
40STS014**	Special Course on Data Assimilation	2	This is a course of seminar and practice on sequential data assimilation methods or variational data assimilation methods. On the basis of the state-space model, students derive the sequential methods or the variational methods, and implement the procedure.

Statistical Science

Course Code	Course	Credit	Content of Subject
40STS015**	Basic Theory of Point Processes	2	This course is on the foundamental mathematical theory of point processes. It introduces basic concepts and theories related point processes, including random measures, Janossy measures, Janossy density, Campbell measure, moment measure, conditional intensity, Papangelou intensity, and Palm intensity. Its objectives include: (1) To learn the point process theory from the viewpoint of modern probability theory. (2) To understand the theoretical relationship between each type of point processes.
40STS016**	Applied Probability	2	In this lecture, we will outline the basics of stochastic processes, including Poisson processes, random walks, and Brownian motion, while showing examples of applications of stochastic processes. In addition, we will explain the mathematical economic analysis of resource management risks by applying macro-renewable resource supply forecasting and option theory, targeting renewable resources such as forests.
40STS017**	Multimedia Information Processing	2	The digital age has fostered the broadcasting of an ever increasing quantity of complex multimedia documents, be it through the internet or more versatile electronic channels. These evolutions have called for new tools and technologies to classify and analyze multimedia contents. We study in this course algorithms which are useful for these tasks.(Not offered in AY 2026)
40STS018**	Spatial Statistics and Stochastic Geometry	2	In this course, I will lecture spatial modeling for spatial data such as geostatistics, lattice model, directional statistics, and spatial point process, as well as random partitioning and random packing. Unlike the generalized linear model and its related statistics, a likelihood of a spatial model is not a simple product over independent data, which is one of essences for spatial modeling.

Statistical Science

Course Code	Course	Credit	Content of Subject
40STS019**	Genomic Data Analysis	2	This course deals with data analysis of genetic information by applying the methods of statistical science. To infer the phylogenetic relationships of organisms, we compare homologous genes between organisms. Explanations and exercises will be given on how to construct a model for that purpose and maximum likelihood estimation of phylogenetic trees.
40STS020**	Topics in Sampling Theory	2	This course deals with the design of data collection, focusing on sample survey methods, and statistical inference under that design. Following three topics will be covered: (1) sample survey methods used in social surveys, (2) design of experiments and observational studies in contrast to survey research, and (3) typical data analysis methods for survey data. The course will consist mainly of lectures, with some simple exercises in the latter part.
40STS021**	Survey Design	2	This course covers systematic explanations of practical methodologies of survey design for organizations or regions.
40STS022**	Machine Learning for Statistical Natural Language Processing	2	This course deals with the basic probabilistic framework for statistical treatment of natural language and related discrete data. It will cover the basic statistical and computational methods necessary to understand the characteristics of high-dimensional discrete data.
40STS023**	Statistical Mathematics Seminar 1	1	This is a general course of statistical science. Students are requested to attend the statistical mathematics seminar held at the institute of statistical mathematics to learn various recent developments in statistical science.

Statistical Science

Course Code	Course	Credit	Content of Subject
40STS024**	Statistical Mathematics Seminar 2	1	This is a general course of statistical science. Students are requested to attend the statistical mathematics seminar held at the institute of statistical mathematics to learn various recent developments in statistical science.
40STS025**	Statistical Mathematics Seminar 3	1	This is a general course of statistical science. Students are requested to attend the statistical mathematics seminar held at the institute of statistical mathematics to learn various recent developments in statistical science.
40STS026**	Statistical Mathematics Seminar 4	1	This is a general course of statistical science. Students are requested to attend the statistical mathematics seminar held at the institute of statistical mathematics to learn various recent developments in statistical science.
40STS027**	Statistical Mathematics Seminar 5	1	This is a general course of statistical science. Students are requested to attend the statistical mathematics seminar held at the institute of statistical mathematics to learn various recent developments in statistical science.
40STS028**	Special Topics in Statistical Inference and Mathematics 1	2	Probability theory is basic mathematics for statistical science. This course deals with mathematical topics that link to statistical applications.
40STS029**	Special Topics in Statistical Inference and Mathematics 2	2	One of the topics below will be chosen: (1) Distribution theory, asymptotic theory, statistical inference, (2) Gaussian random processes/fields, (3) Contingency table and graphical model, (4) Differential and integral geometric approach to statistics, (5) Algebraic statistics, (6) Random matrices, (7) Mathematics in statistics including convex analysis, combinatorics, and measure theory.
40STS030**	Statistical Computing	2	Lectures on statistical computing using a parallel computer will be given in this course. In particular, the following subjects will be discussed: problems which requires huge matrices, the particle filter using a parallel computer, and implementation of the ensemble Kalman filter on a parallel computer.

Statistical Science

Course Code	Course	Credit	Content of Subject
40STS031**	Information Security	2	This course covers major privacy-preserving techniques such as anonymization, differential privacy, and statistical disclosure control, which realize safe analysis of big data. We also cover topics on machine learning security with emphasis on empirical evaluation methods.
40STS032**	Bayesian Computation	2	The course covers some theoretical and methodological topics of Bayesian computation. Markov chain Monte Carlo methods are also covered.
40STS033**	Special Topics in Environmental Statistics	2	The goal of this course is to provide students with the ability to understand and implement the various statistical methods used in environmental data analysis. Students will read the textbooks and attend lectures on specific topics.
40STS034**	Financial Statistics	2	Concrete cases will be presented and research lectures will be given on theoretical methodologies for quantification of credit risk, risk assessment of financial markets, and investment strategies. In particular, students will acquire practical knowledge of statistical models that are consistent with relevant laws and regulations such as the Basel Accord and corporate accounting, forecasting using stochastic processes and time-series models, and risk assessment through the use of actual data.
40STS035**	Longitudinal Data Analysis	2	This course focus on the study of statistical models, such as linear mixed-effects models and their extensions, used in the longitudinal data analysis in which a response variable is measured repeatedly over time for multiple subjects. The course will also focus on the study of research designs, such as randomization, and on the study of statistical methods used in actual problems.
40STS036**	Special Topics in Biostatistics	2	This course deals with recent relevant topics on biostatistics, especially, (i) Biostatistical methodology on clinical and epidemiologic studies, (ii) Designs and analyses of clinical trials, (iii) Evidence synthesis methods, and (iv) statistical analyses of large-scale genomic data.

Statistical Science

Course Code	Course	Credit	Content of Subject
40STS037**	Application in Data Science	2	This course deals with various data analysis methods for practical applications, including statistical machine learning, deep learning, Bayesian inference, Python/R programming, etc., through several case studies including materials data analysis.
40STS038**	Bayesian Uncertainty Quantification for Engineering Applications	2	Students will learn about the concept and implementation of uncertainty quantification for Bayesianinference of physical models. Examples of model comes from structural engineering, geotechnicalengineering, etc.
40STS039**	Statistical Inference	2	This course introduces the estimation and testing of regression models with nonlinearities and related statistical theory as basic topics, and treats sparse modeling, robust statistics, missing data analysis, deivergence-based inference as advanced topics.
40STS040**	Statistical Machine Learning	2	Research work is directed on the methodology of statistical machine learning such as deep learning and kernel methods for analyzing large high-dimensional data. The course aims to provide students with knowledge of machine learning theory and methods, and the ability to apply machine learning methods to data analysis. The course will be conducted in the form of seminars, and students will be evaluated based on their presentations.
40STS041**	Special Topics in Signal Processing	2	Basic theories of signal processing such as Fourier and wavelet transforms, principal component analysis and independent component analysis are explained. Practical examples will be given, using sound processing, image processing, biomedical measurement signals and astronomical data analysis as examples.

Statistical Science

Course Code	Course	Credit	Content of Subject
40STS042**	Parametric Statistical Models	2	This course introduces well-known multivariate probability distributions in statistics, such as the multivariate normal distribution, the multivariate t distribution, the multinomial distribution, exponential families, and copulas, and discusses the statistical theory of these distributions. It also considers parametric statistical models, including regression models based on these distributions.
40STS043**	Systems Optimization	2	This course is intended to serve an introduction to systems design and focuses on the theoretical aspects of mathematical optimization based on convex analysis, duality theory, numerical linear algebra, and functional analysis.
40STS044**	Stochastic Models	2	This course covers fundamental topics and applications in Markov chains and their representations, as well as algebraic Monte Carlo methods and exchangeability in modelling for uncertainty quantification.
40STS045**	Topics of Statistical Inference	2	We study the theory of semiparametric inference, its application and (or) some related topics. The standard knowledge of mathematical statistics and the basic mathematical skill on calculus, abstract linear algebra, metric space (or general topology) and probability theory are required.
40STS046**	Irregular Statistical Theory	2	After outlining asymptotic theory for regular statistical models, asymptotic theory for locally conic models will be introduced and the geometric methods required in their evaluation will be explained. Alternatively, after outlining the basic methods for causal inference, semiparametric approaches using propensity scores will be introduced and information criteria for causal inference models will be explained. The goal of the lecture is to provide fundamentals and developments of statistical asymptotics or causal inference.

Statistical Science

Course Code	Course	Credit	Content of Subject
40STS047**	Convex Analysis and Conic Optimization	2	In this course we will discuss the fundamentals of convex analysis such as separation theorems, subdifferential theory and several duality results. At the end, we will discuss some extensions and related topics. Alternatively, we might also discuss modelling and theoretical aspects of conic linear programs.
40STS048**	Topics in Computational Mathematics	2	This course deals with numerical algorithms in mathematical optimization and related areas. Specifically, we choose some topics in numerical algorithms for continuous optimization problems, matrix and eigenvalue problems, and so on, and discuss their mathematical foundations.
40STS049**	High Dimensional Probability and Statistics	2	This course discusses topics in probability and statistics in higher and infinite dimensions.
40STS050**	Mean Field Theory for Random System	2	Students will learn the mean field theory for random systems: (1) how to analyze magnetic models (2) basic analytical methods. (Not offered in AY 2026)
40STS051**	Introduction to Statistical Science	2	After dealing with probability including random variables, probability distributions, expectation and variance, students will learn methods indispensable for statistical analysis, such as point estimation, interval estimation and statistical hypothesis testing..
40STS052**	Survival Analysis	2	Survival analysis deals with patients' and/or equipments' survival time data. When analyzing survival data, one typically entounters incompletely observed survival times that are censored or truncated. This type of survival data arises in a variety of fields, including medicine, reliability, ecology, insurance, economics, finance, and marketing. In this course, we study statistical models and inference methods based on survival data. (Not offered in AY 2026)

Statistical Science

Course Code	Course	Credit	Content of Subject
40STS053**	Topics in combinatorial optimization	2	Lectures or seminars on basic topics of combinatorial optimization and algorithm design will be given. The topics will include linear programming, matching, network flows, matroids, and submodular functions, but other topics may be covered depending on the interests of the students.
40STS054**	Addvanced Spatial Statistics	2	This lecture introduces statistical methods for spatial data and their applications. Specifically, methods in geostatistics, spatial econometrics, and relevant areas are introducesd together with their implementation with R.
40STS055**	Differential Privacy	2	This course deals with differential privacy (DP), which is known as a de facto standard privacy notion for privacy protection. We first study some basic topics, such as the privacy properties of DP, the Laplace and exponential mechanisms, the composition theorems, and the SVT (Sparse Vector Technique). Then, we study more advanced topics, such as various extensions/variants of DP, the local model, and the shuffle model.
40STS056**	Nonlinear Optimization for Large-scale Machine Learning	2	Semiar and research guidance on nonlinear optimization algorithm and analysis, with a focus on those suitable for real problems in large-scale machine learning.
40STS057**	Special Topics in Learning Theory	2	This course covers advanced topics in modern statistical learning theory in the format of either lecture or paper reading. Specifically, these topics are in the scope: gradient flow dynamics of neural networks, gradient descent dynamics, implicit bias, and structured prediction.
40STS058**	Advanced Materials Data Analysis	2	This course offers a systematic study of Materials Informatics, covering topics from the fundamentals to advanced applications. The goal is to equip students with both theoretical understanding and practical implementation skills. Participants are expected to have a basic knowledge of Python. Learning will be conducted through hands-on exercises, running source code on JupyterLab. The course covers foundational concepts in materials science and data analysis, methods for acquiring existing datasets, and practical training in performing data analysis with Python.

Statistical Science

Course Code	Course	Credit	Content of Subject
80STS001**	Statistical Science Study 1	2	This is a general research course of statistical science. Students are requested to present progress of their research by giving seminars and talks.
80STS002**	Statistical Science Study 2	2	This is a general research course of statistical science. Students are requested to present progress of their research by giving seminars and talks.
80STS003**	Statistical Science Study 3	2	This is a general research course of statistical science. Students are requested to present progress of their research by giving seminars and talks.
80STS004**	Statistical Science Study 4	2	This is a general research course of statistical science. Students are requested to present progress of their research by giving seminars and talks.
80STS005**	Statistical Science Study 5	2	This is a general research course of statistical science. Students are requested to present progress of their research by giving seminars and talks.
80STS006**	Statistical Science Study 6	2	This is a general research course of statistical science. Students are requested to present progress of their research by giving seminars and talks.
80STS007**	Statistical Science Study 7	2	This is a general research course of statistical science. Students are requested to present progress of their research by giving seminars and talks.
80STS008**	Statistical Science Study 8	2	This is a general research course of statistical science. Students are requested to present progress of their research by giving seminars and talks.
80STS009**	Statistical Science Study 9	2	This is a general research course of statistical science. Students are requested to present progress of their research by giving seminars and talks.
80STS010**	Statistical Science Study 10	2	This is a general research course of statistical science. Students are requested to present progress of their research by giving seminars and talks.