

Special Subjects of the Department of Statistical Science

Field	Course Code	Subject	Credit	Content of subject	Instructor
Statistical Modeling	20DSSa01**	Special Topics in Statistical Modeling I	2	Starting with a linear model that is the basis of statistical modeling. Then, learn the basics of sparse modeling and how to apply its methodologies to real problems.	Hideitsu Hino
	20DSSa02**	Special Topics in Statistical Modeling II	2	When trying to solve practical problems with data driven approaches, it is critical to formulate the original problem as a “feasible” sub-problem. In this course, we study the methodology on how to formulate various practical problems and to efficiently solve them.	Hideitsu Hino
	20DSSa36**	Statistical Computing	2	Statistical computing using parallel computing is the subject of 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. ※Students who have already taken “Statistical Computing II (20DSSa06)” can’t take this subject.	Shin'ya Nakano
	20DSSa34**	Complex Systems Analysis I	2	The aim of this course is to study the deterministic and stochastic approach in time series analysis.	Fumikazu Miwakeichi
	20DSSa35**	Complex Systems Analysis II	2	This course covers methods to extract significant signals, spatial correlation and causality analysis from time series data.	Fumikazu Miwakeichi
	20DSSa11**	Monte Carlo algorithms and stochastic simulation	2	This course deals with Monte Carlo algorithms and stochastic simulation methods with real world applications.	Yukito Iba
	20DSSa12**	Modeling of complex hierarchical structures	2	This course focused on statistical modeling of complex and hierarchical systems.	Yukito Iba
	20DSSa15**	Digital Signal Processing	2	This lecture provides basic methods of treatment on signals and transfer functions based on z-transformation with practical design skill for digital system including prediction filters.	Yumi Takizawa
	20DSSa16**	Communication and Information Systems	2	This lecture provides basic study of information theory by C.E.Shannon referring to contitative expression of information, fundamental characteristics and coding methods for information source and communication channel.	Yumi Takizawa
	20DSSa27**	Information Security I	2	This course covers privacy-preserving data mining techniques for analyzing big data with sensitive information safely.	Kazuhiro Minami
	20DSSa28**	Information Security II	2	This course covers anonymization and differential privacy techniques for publishing datasets for secondary use safely.	Kazuhiro Minami
	20DSSa17**	Special Topics in Time Series Analysis I	2	This course will cover vector autoregressions and their applications to causal analysis of time series. To extend the arguments to non-stationary time series, after learning unit root tests to check the persistency of time series, we will proceed to the testing and estimation of cointegrated systems.	Yoshinori Kawasaki

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Statistical Modeling	20DSSa18**	Special Topics in Time Series Analysis II	2	This course will cover various types of time series models in which variance or conditional variance is allowed to vary. The following topics will be discussed; conditional heteroscedasticity models and their multivariate version, parameter-driven time varying variance models, realized volatility, realized quarticity, heterogeneous autoregression model.	Yoshinori Kawasaki
	20DSSa31**	Stochastic systems I	2	This course provides an elementary introduction of stochastic analysis and its applications.	Shinsuke Koyama
	20DSSa32**	Stochastic Modeling II	2	This course provides advanced topics on stochastic modeling and analysis.	Shinsuke Koyama
	20DSSa19**	Special Course on Data Assimilation I	2	This is a course of seminar and practice on sequential data assimilation methods such as the ensemble Kalman filter. On the basis of the state-space model, students derive the sequential methods and implement the procedure.	Genta Ueno
	20DSSa20**	Special Course on Data Assimilation II	2	This is a course of seminar and practice on variational data assimilation methods such as the adjoint method. On the basis of maximum a posteriori (MAP) estimation of the state-space model, students derive the variational methods and implement the procedure.	Genta Ueno
	20DSSa23**	Basic theory of Point Processes	2	This course gives an introduction to the probability theory of point processes, including the concepts of random measures, Janossy density, Janossy measure, Campbell measure, moment measure, conditional intensity, Papangelou intensity, Palm intensity, etc.	Zhuang, Jiancang
	20DSSa24**	Statistical Inferences for Point Processes	2	This course is on the techniques related to statistical inferences for random events in time and/or geographical space. In details, we focus on the issues of model construction, information recognition, model diagnostics, model selection, simulation, forecasting, forecast evaluation, etc.	Zhuang, Jiancang
	20DSSa33**	Spatio-temporal Data Analysis	2	Statistical modelling and analysis of spatio-temporal data and their applications are covered in this course. In particular, the subjects which are applied for geoscience data analysis such as data assimilation will mainly be discussed.	Shin'ya Nakano
	20DSSc16**	Control Theory I	2	[Not offered in 2022]	
	20DSSc17**	Control Theory II	2	[Not offered in 2022]	
	20DSSc20**	Applied Probability I	2	Through this course, applications of a counting process, queueing theory and other stochastic processes are emphasized for prediction of renewable resources supply prediction and control.	Atsushi Yoshimoto
	20DSSc21**	Applied Probability II	2	Through this course, application of option theory and mathematical economics are studies for risk management of renewable resources.	Atsushi Yoshimoto
	20DSSa13**	Communication Information Processing	2	Spoken language is a crucial component of human communication. In this course, we study algorithms to efficiently process and analyze not only the text information but also the speaker information from spoken language.	Tomoko Matsui

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Statistical Modeling	20DSSa14**	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.	Tomoko Matsui
	20DSSa37**	Bayesian Computation I	2	The first half of the course covers the basic Bayesian computation. The second part deals with Markov chain ergodicity and Markov chain Monte Carlo methods. Students are expected to have basic knowledge of <u>measure theory and statistics</u> .	Kengo Kamatani
	20DSSa38**	Bayesian Computation II	2	The first half of the course covers the basic Bayesian computation. The second part deals with Markov chain ergodicity and Markov chain Monte Carlo methods. Students are expected to have basic knowledge of <u>measure theory and statistics</u> .	Kengo Kamatani
	90DSSa01**	Statistical Modeling Research I	2	This is a general course on statistical science consisting of seminars, special lectures and practice. Special emphasis is given to statistical modeling and modeling methodologies.	All the teaching staff in the field of Statistical Modeling
	90DSSa02**	Statistical Modeling Research II	2		
	90DSSa03**	Statistical Modeling Research III	2		
	90DSSa04**	Statistical Modeling Research IV	2		
90DSSa05**	Statistical Modeling Research V	2			
Statistical Data Science	20DSSb03**	Spatial Statistics	2	Lectures are given on Spatial Statistical modeling and statistical inferences about spatial data. Basic statistical analytic techniques for sampled data from a continuously changing variable, lattice data (e.g. data are given for each prefecture or city), point patterns (configuration), and circular data are explained.	Kenichiro Shimatani
	20DSSb04**	Stochastic Geometry	2	Offers a series of lectures on statistical models of spatial events, such as the models of "Stochastic Geometry" (spatial tessellation, random packing and so on) together with their mathematical foundation and application. Exercises related to problems in "Stochastic Geometry" are also given.	Kenichiro Shimatani
	20DSSb05**	Genomic Data Analysis I	2	Genomic data analysis using inferring phylogenies from DNA sequences and their applications to evolutionary problems.	Jun Adachi
	20DSSb06**	Genomic Data Analysis II	2	Analysis of mechanisms of genome evolution and comparison of the genome structure.	Jun Adachi
	20DSSb09**	Topics in Sampling Theory I	2	This course deals with various research designs and statistical inference based on data collected under these designs, with special emphasis on sampling theory. It aims to enhance the students' understanding of the importance of the design stage of reserach process.	Tadahiko Maeda
	20DSSb11**	Topics in Social Research	2	This course deals with statistical approaches to various problems in the administration of social surveys, such as questionnaire design, non-sampling errors, survey mode comparison, and so on. Taking a few domestic and overseas surveys as examples, we will discuss various sources of errors in those surveys.	Tadahiko Maeda

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Statistical Data Science	20DSSb16**	Special Topics in Survey Data Analysis II	2	This course covers exploratory data analysis methods for data obtained from surveys in the fields of social sciences. Exercises using statistical software package are also carried out.	Yoosung Park
	20DSSb19**	Biostatistics	2	We study the application of statistical methods to problems concerning the medical and biological sciences.	Koji Kanefuji
	20DSSb20**	Environmental Statistics	2	We study the application of statistical methods to problems concerning the environment.	Koji Kanefuji
	20DSSb21**	Financial Statistics I	2	The course provides students with necessary knowledge and techniques in control and evaluation of credit financial risks. Also, the course introduces leading-edge technology in banks and other financial agencies.	Satoshi Yamashita
	20DSSb22**	Financial Statistics II	2	The course provides students with necessary case studies and techniques in control and evaluation of financial market risks. Also, the course introduces investment statistical models in pension funds and other financial agencies.	Satoshi Yamashita
	20DSSb23**	Statistics in Medicine I	2	The aim of this course is to study the statistics in medicine and public health focusing on statistical models such as linear mixed effects models in longitudinal data analysis.	Ikuko Funatogawa
	20DSSb24**	Statistics in Medicine II	2	The aim of this course is to study the statistics in medicine and public health focusing on the design such as randomization and also statistics in actual health problems.	Ikuko Funatogawa
	20DSSb27**	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.	Hisashi Noma
	20DSSb28**	Applied Statistics I	2	This course deals with practical data analysis methods widely applied in scientific investigation and research, involving practices using statistical software R.	Hisashi Noma
	20DSSa25**	Biological System Analysis I	2	This course covers a range of statistical methods in bioinformatics and materials informatics. Starting from a brief overview of machine learning and R language programming, the essence of statistical modeling and inference is illustrated through applications in DNA sequence analysis, bioimage informatics, material design problems, and so on.	Ryo Yoshida
	20DSSa26**	Biological System Analysis II	2	As the second course of "Biological System Analysis I", this course conducts studies of more practical and advanced machine learning techniques in bioinformatics and materials informatics.	Ryo Yoshida

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Statistical Data Science	20DSSb31**	Survey Design	2	This course covers systematic explanations of practical methodologies of survey design for organizations or regions.	Yoosung Park
	20DSSb32**	Bayesian uncertainty quantification for engineering applications	2	Students will learn about the concept and implementation of uncertainty quantification for Bayesian inference of physical models. Examples of model comes from structural engineering, geotechnical engineering, etc.	Wu Stephen
	20DSSb33**	Statistics for earthquake early warning	2	Students will learn about statistical modeling and inference of earthquake early warning, including time series analysis of seismic waves and Bayesian inference.	Wu Stephen
	90DSSb01**	Statistical Data Science Research I	2	This is a general course on statistical science consisting of seminars, special lectures and practice. Special emphasis is given to methodologies on survey and sampling, data analysis and statistical software.	All the teaching staff in the field of Statistical Data Science
	90DSSb02**	Statistical Data Science Research II	2		
	90DSSb03**	Statistical Data Science Research III	2		
	90DSSb04**	Statistical Data Science Research IV	2		
90DSSb05**	Statistical Data Science Research V	2			
Statistical Inference and Mathematics	20DSSc03**	Theory of Statistical Inference	2	Robust inference against outlier, including robust estimation, test and model selection.	Hironori Fujisawa
	20DSSc04**	Special Topics in Data Analysis I	2	Statistical methods for analysis of data, especially for analysis of medical data.	Hironori Fujisawa
	20DSSc05**	Special Topics in Data Analysis II	2	Explore sampling algorithms from discrete stochastic models.	Shuhei Mano
	20DSSc06**	Statistical Machine Learning	2	This course discusses machine learning methods for analyzing large and high dimensional data.	Kenji Fukumizu
	20DSSc07**	Statistical Natural Language Processing	2	We discuss basic statistical methods for natural language or similar discrete data, and related problems for inference and learning.	Daichi Mochihashi
	20DSSc08**	Bayesian Modeling and Inference Methods	2	Advanced modeling and scientific computing to combine a wide variety of information sources within a framework of Bayesian approach. Computational methods for Bayesian inference are also discussed.	Daichi Mochihashi
	20DSSc09**	Multivariate Statistical Inference I	2	One of the topics below will be chosen: (1) Contingency table and graphical model (2) Distribution theory and statistical inference (3) Differential and integral geometric approach to statistics (4) Algebraic statistics (5) Random matrices.	Satoshi Kuriki
	20DSSc10**	Multivariate Statistical Inference II	2	Seminar on a particular topic related to multivariate analysis, categorical data analysis, graphical models, asymptotic inference, distribution theory, random field, algebraic statistics, high-dimensional statistics, and relevant mathematics such as differential geometry, convex analysis, combinatorics and measure theory.	Satoshi Kuriki

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Statistical Inference and Mathematics	20DSSc31**	Statistical Learning Theory	2	This course discusses theory and methodology for automatic knowledge acquisition from data, based on mathematical methods such as probability, functional analysis, geometry, and discrete mathematics. ※Students who have already taken "Statistical Learning Theory II (20DSSc12)" can't take this subject.	Kenji Fukumizu
	20DSSc14**	Special Topics in Signal Processing I	2	This course introduces the basic theory of signal processing including the Principal Component Analysis and Independent Component Analysis.	Shiro Ikeda
	20DSSc15**	Special Topics in Signal Processing II	2	This course introduces how to apply signal processing methods to real data analysis including speech signals and biological data.	Shiro Ikeda
	20DSSc23**	Regression Analysis	2	This course deals with some topics on the theory of regression analysis, especially, generalized linear models. In addition, applications of the theory of regression analysis to real problems are discussed.	Shogo Kato
	20DSSc24**	Distribution Theory	2	This course provides an overview of the theory of probability distributions which are commonly used in statistics. Statistical models related to these distributions are also discussed.	Shogo Kato
	20DSSc18**	Systems Optimization I	2	This course is intended to serve an introduction to systems design and analysis, and focuses on the theoretical aspects of convex optimization based on convex analysis, duality theory and numerical linear algebra.	Satoshi Ito
	20DSSc19**	Systems Optimization II	2	We will discuss several specific topics in mathematical optimization, including hierarchical optimization, robust optimization and infinite-dimensional optimization, with some applications in control, signal processing, machine learning and other systems design.	Satoshi Ito
	20DSSc22**	Stochastic Models	2	Explore discrete stochastic models with algebraic dependencies.	Shuhei Mano
	20DSSb07**	Topics of Statistical Inference I	2	The aim of this course is to study the theory and application of statistical inference based on semiparametric models with infinite-dimensional nuisance parameters.	Masayuki Henmi
	20DSSb08**	Topics of Statistical Inference II	2	We study the differential geometry of statistical inference, by focusing the foundation of information geometry and overviewing its application to some topics of statistical inference.	Masayuki Henmi
	20DSSc27**	Special Topics in Statistical Asymptotic Theory	2	After outlining statistical asymptotic theory for regular statistical models, the one for locally conic models is introduced and a geometrical approach for its evaluation is explained.	Yoshiyuki Ninomiya
	20DSSc28**	Change-Point Analysis	2	After an overview of statistical asymptotics in the presence of a kind of non-differentiability, such as change-point analysis and quantile regression, the information criterion derived in this setting is introduced.	Yoshiyuki Ninomiya

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Statistical Inference and Mathematics	20DSSc29**	Probability theory and its applications I	2	This course is an introductory lecture on Lévy process. Lévy process is a stochastic process with independent and stationary increments. Essential knowledge is explained systematically.	Takaaki Shimura
	20DSSc30**	Probability theory and its applications II	2	This course deals with extreme value theory and its statistical applications.	Takaaki Shimura
	20DSSc34**	Convex analysis and beyond	2	In this course, we focus on the fundamentals of convex analysis. We will go through the basics of convex sets, convex functions and discuss topics such as: separation theorems, subdifferentials, conjugacy and duality. At the end, we will discuss some topics that either extend or complement the previous topics.	FIGUEIRA LOURENÇO BRUNO
	20DSSc35**	Conic optimization	2	In this course, we discuss the fundamentals of conic optimization with a focus on modeling and the theoretical analysis of conic optimization problems.	FIGUEIRA LOURENÇO BRUNO
	20DSSc38**	Topics in Computational Mathematics	2	This course chooses a topic of numerical computation in mathematical optimization or related areas and provides lectures or holds seminars. Examples of specific topics include, but are not limited to, theory of iterative methods in continuous optimization, theory of numerical linear algebra, and so on.	Mirai Tanaka
	20DSSc39**	Topics in Mathematical Programming	2	This course chooses a topic in applied optimization and holds seminars to learn modeling and algorithms. Examples of specific topics include, but are not limited to, model building in mathematical optimization, optimization with uncertainty, applications of optimization.	Mirai Tanaka
	20DSSc36**	Theory of predictive density	2	This seminar discusses theory and application of predictive density.	Keisuke Yano
	20DSSc37**	High dimensional probability and statistics	2	Seminar on topics such as (1) empirical processes, (2) high-dimensional central limit theorems, and (3) concentration inequalities.	Keisuke Yano
	20DSSc32**	Mean field theory for random system I	2	This course deals with mean field theory for random systems.	Ayaka Sakata
	20DSSc33**	Mean field theory for random system II	2	This course deals with mean field theory for random systems.	Ayaka Sakata
	90DSSc01**	Statistical Inference and Mathematics I	2	This is a general course on statistical science consisting of seminars, special lectures and practice. Special emphasis is given to mathematical/inferential/computational aspects of statistical science.	All the teaching staff in the field of Statistical Inference and Mathematics
	90DSSc02**	Statistical Inference and Mathematics II	2		
	90DSSc03**	Statistical Inference and Mathematics III	2		
	90DSSc04**	Statistical Inference and Mathematics IV	2		
	90DSSc05**	Statistical Inference and Mathematics V	2		
Common	90DSSd01**	Statistical Science Study I	2	This is a general research course of statistical science. Students are requested to present progress of their research by giving seminars and talks.	All the teaching staff of Department of Statistical Science
	90DSSd02**	Statistical Science Study II	2		
	90DSSd03**	Statistical Science Study III	2		
	90DSSd04**	Statistical Science Study IV	2		
	90DSSd05**	Statistical Science Study V	2		

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Common	90DSSd06**	Statistical Science I	2	This is a general course on statistical science consisting of seminars and special lectures. Emphasis is laid on important advanced topics in statistical science.	All the teaching staff of Department of Statistical Science
	90DSSd07**	Statistical Science II	2		
	90DSSd08**	Statistical Science III	2		
	90DSSd09**	Statistical Science IV	2		
	90DSSd10**	Statistical Science V	2		
	90DSSd11**	Statistical Mathematics Seminar I	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.	All the teaching staff of Department of Statistical Science
	90DSSd12**	Statistical Mathematics Seminar II	1		
	90DSSd13**	Statistical Mathematics Seminar III	1		
	90DSSd14**	Statistical Mathematics Seminar IV	1		
	90DSSd15**	Statistical Mathematics Seminar V	1		

A two-digit number or letter will be entered to ** according to the semester or the lecturer in charge.