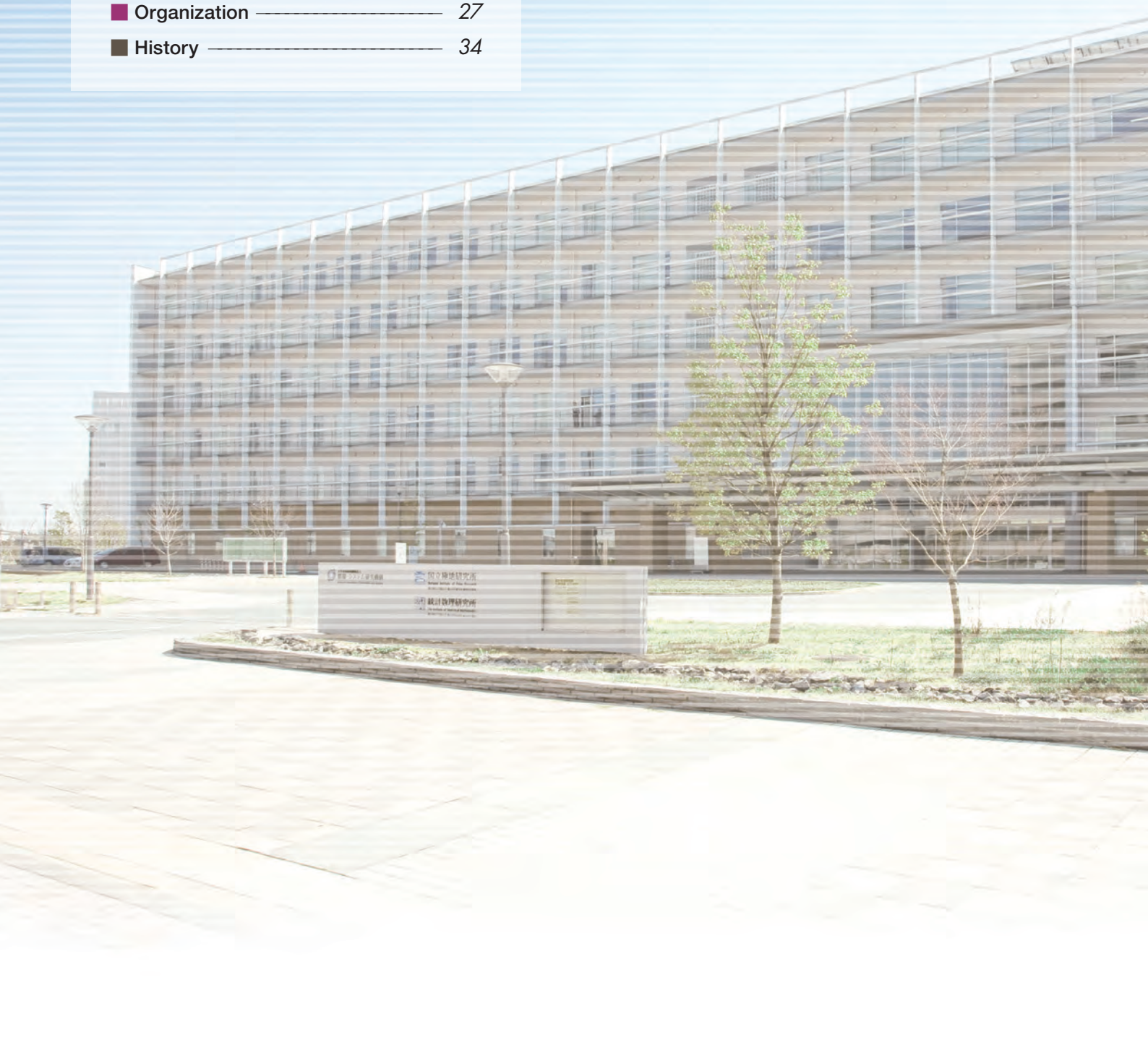
2023
-
2024

Research Organization of Information and Systems

The Institute of Statistical Mathematics

CONTENTS

- Message from Director-General — 1
- Institute Overview — 2
- Research Topics — 4
- ISM Projects — 14
  - NOE (Network Of Excellence) Project
  - Project for Fostering and Promoting Statistical Thinking
  - Project for Training Experts in Statistical Sciences
- Research Cooperation — 20
- Graduate School Program — 22
- Facilities and Equipment — 25
- Finance and Buildings — 26
- Organization — 27
- History — 34



Message from Director-General

The Institute of Statistical Mathematics (ISM) was established in 1944 under the management of the Ministry of Education. Since then, ISM has been dedicated to meeting the needs of the times and environment by developing novel mathematical methods for data acquisition, interpretation, modeling, and decision-making to support multiple disciplines. Statistical and mathematical sciences do not exist in a vacuum. The legacy of ISM is built upon the belief that mathematical analysis of reality and facts paves the way to discovering the truth. Our primary mission in fundamental research is to continually create high-quality mathematical models that reconstruct reality and facts.

It is also our mission to develop and apply powerful statistical and mathematical sciences methodologies and solve social challenges identified through multidisciplinary or industry-government-academia collaborations. Per the Fourth Medium-Term Plan, we are implementing international joint programs using available resources efficiently while simultaneously pursuing the Network Of Excellence (NOE) Project to expand joint activities in a top-down manner and apply statistical and mathematical sciences to key research domains. The following NOE-based activities are particularly noteworthy: (i) international collaborations led by the Research Center for Statistical Machine Learning, (ii) "Creation of data infrastructure for data-driven polymer materials research" project approved under the Program for Promoting Research on the Supercomputer Fugaku, and (iii) "New developments in space-time earthquake forecasting and monitoring: from long-term to real-time" project, approved under the Seismology TowArd Research innovation with data of Earthquake (STAR-E) Project. The second and third activities are represented by the Data Science Center for Creative Design and Manufacturing and the Risk Analysis Research Center, respectively.

ISM's further mission is to nurture specialists in statistical and mathematical sciences. Compared to other countries, Japan has few postgraduate statistics courses. This has led to a shortage of experts in this field. The national policy to foster specialists who can effectively utilize mathematics, data science, and artificial intelligence technologies underscores the role of ISM. Along with the Project for Fostering and Promoting Statistical Thinking, the Project for Training Experts in Statistical Sciences, hosted by the Center for Training Professors in Statistics, encourages junior and mid-career researchers from 29 academic institutions to interact and collaborate with leading senior statistical scientists. This project equips postgraduate statistics educators from various disciplines with the necessary educational tools and systems to incorporate statistics into their courses.

ISM's Fourth Medium-Term Plan began in April 2022. More than three years have passed since the sudden global outbreak of COVID-19. The pandemic imposed tremendous restrictions and changes to ISM's activities. However, most COVID-19-related mandatory behavioral restrictions will be lifted in FY 2023. We are adapting to these changes as outlined in our latest medium-term plan to facilitate the research and education activities of ISM, including resource adjustment and structural reorganization.

Finally, on behalf of ISM's faculty and staff, I want to express our gratitude for the many industry, government, and academia stakeholders who support our statistical and mathematical sciences research. We thank you for your continued understanding and support.

Hiroe Tsubaki
Director-General
The Institute of Statistical Mathematics

Institute Overview

Basic Research

Department of Statistical Modeling

The Department of Statistical Modeling works on structural modeling of physical phenomena related to numerous factors, and conducts research on model-based statistical inference methodologies. By means of model-based prediction and control, modeling of complex systems, and data assimilation, the department aims to contribute to the development of modeling intelligence in many fields.

Prediction and Control Group

The Prediction and Control Group works on the development and evaluation of statistical models, which function effectively in terms of prediction and control of phenomena, decision making, and scientific discoveries. These efforts involve data analysis and modeling related to phenomena that vary across time and space.

Complex System Modeling Group

The Complex System Modeling Group conducts studies aimed at discovering the structures of complex systems, such as nonlinear systems and hierarchical networks, through statistical modeling. For these purposes, the group also considers Monte Carlo simulations, discrete mathematics, and computer science.

Data Assimilation Group

The Data Assimilation Group works on the development of data assimilation techniques, which are procedures aimed at combining information derived from large amounts of observations and a numerical simulation model. By developing computational algorithms and high-performance parallel computing systems, the group aims to build a next-generation simulation model that can predict the future in real time.

Department of Statistical Data Science

The Department of Statistical Data Science conducts research on data design methods aimed at managing uncertainty and incompleteness of information, quantitative methods for evidence-based practice, and related data analysis methods. Moreover, the department investigates methods for inferring the latent structures in target phenomena from observation data.

Survey Science Group

The Survey Science Group promotes research on the design of statistical surveys, development of statistical analysis methods on survey data, privacy protection in official statistics, and their applications. By exploring complex phenomena in various fields, the group also aims to contribute to practical applications in academia and policy-making through social surveys.

Metric Science Group

The Metric Science Group conducts research aimed at identifying and evaluating statistical evidence through quantification of phenomena that have not been measured thus far, as well as efficient information extraction from large databases. The group investigates related methods and develops methods for analyzing the collected data. By working on applied research in various fields of real science, the group aims to advance practical, applied, statistical mathematical research based on evidence.

Structure Exploration Group

The Structure Exploration Group conducts research on statistical science aimed at inferring the latent “structure” behind various target phenomena in biology, physics, and social science, based on observational data. The group focuses on machine learning, Bayesian reasoning, experimental design methods, and spatial-temporal analysis methods to investigate micro/meso/macroscopic and spatial-temporal dynamic structures in target phenomena.

Department of Statistical Inference and Mathematics

The Department of Statistical Inference and Mathematics carries out research into general statistical theory, statistical learning theory, optimization, and algorithms for statistical inference.

Mathematical Statistics Group

The Mathematical Statistics Group is concerned with aspects of statistical inference theory, modeling of uncertain phenomena, stochastic processes and their application to inference, probability and distribution theory, and the related mathematics.

Learning and Inference Group

The Learning and Inference Group develops statistical methodologies to describe the stochastic structure of data mathematically and clarify the potential and the limitations of the data theoretically.

Mathematical Optimization Group

The Mathematical Optimization Group focuses on mathematical theory and practical applications of optimization and computational algorithms together with underlying numerical or functional analysis and discrete mathematics.

NOE-type Research

Risk Analysis Research Center

We are conducting research projects to scientifically mitigate the risks that modern society is facing. Our project activities include the following: data analysis related to seismology, finance, environmental science and resource management; research on the theoretical and practical aspects of analyzing spatiotemporal data; development of general statistical methods for risk analysis; and data collection and linkage. Additionally, we operate a research network organization on risk analysis to facilitate interdisciplinary research with the shared objective of establishing a safe and resilient society.

Research Center for Statistical Machine Learning

Machine learning is a research field associated with autonomous systems that can learn their behavior from data. This field is based on both the statistical science concerning inference from data and computer science concerning efficient algorithms. It can be applied to broad disciplines ranging engineering and information science to natural science, such as robotics and brain sciences. Our research center aims at supporting the academic community of this field, as well as producing influential research through various joint projects.

Data Science Center for Creative Design and Manufacturing

We aim to foster new scientific methods for innovative design and manufacturing. Various fields in manufacturing are now facing a revolutionary period. Population reduction and globalization are bringing dramatic changes in the industrial structure in Japan. Countries around the world has actively developed their growth strategies utilizing data science as a driving force. We have accumulated state-of-the-art technologies in data science here. We are devoted to foster and practice advanced methods in data science for design and manufacturing.

Research Center for Medical and Health Data Science

Research Center for Medical and Health Data Science aims to facilitate statistical data science research that covers medical studies, drug developments, health care, and public health. Our research projects involve fundamental mathematics and computational science for medical applications, applied methodology for basic, clinical and social medicine, and modern technology such as artificial intelligence, machine learning, and big data analyses. Furthermore, our research center aims at constructing a research network of the academic community of this field, as well as offering advanced statistical education programs.

Professional Development

School of Statistical Thinking

The mission of the School of Statistical Thinking is to plan and implement various programs for statistical thinking, from extension courses to a professional development program. The researchers affiliated with the school are often involved with specific data analysis projects, which help them to gain hands-on knowledge of data science. We expect such an experienced researcher will play an active role as a number-cruncher, as a modeler, or as a project coordinator.

Center for Training Professors in Statistics

The Center has established the nationwide consortium of universities and promotes the Project for Training Experts in Statistical Sciences to address the critical shortage of professors in statistics, which form the core of data science. Within 5 years from the start of the project, the Center will develop at least 30 university professors in statistics, who will train statistics experts at member universities of the consortium. The Center aims to establish a positive cycle of professional development.

Research Support

Center for Engineering and Technical Support

The Center for Engineering and Technical Support assists academics and their collaborators in many ways: managing computer systems and networks, editing and publishing journals, maintaining the library, and managing tutorial programs.

- **Computing Facilities Unit** The Computing Facilities Unit is in charge of managing computer facilities and scientific software.
- **Computer Networking Unit** The Computer Networking Unit is responsible for computer networking and its infrastructure, and network security.
- **Information Resources Unit** The Information Resources Unit is responsible for maintaining a library and an electronic repository, and is in charge of planning statistical tutorial programs open to the public.
- **Media Development Unit** The Media Development Unit is in charge of publishing and editing of research results and PR brochures.

Bayesian Computation

■ Bayesian inference

Bayesian statistics is a framework of statistical inference that quantifies all uncertainty using probability distributions. Its consistency and clarity of conclusions are its key features. However, its quantification often involves complex computations. Appropriate statistical algorithms are required depending on the situation.

■ Markov Chain Monte Carlo (MCMC) method

The Markov Chain Monte Carlo (MCMC) method is a widely used algorithm that can calculate the characteristics of complex probability distributions, making it essential in Bayesian statistics. Most MCMC methods create a stochastic flow that maintains local balance (reversibility), which enables accurate quantification of uncertainty. However, due to the local balance, MCMC methods tend to be diffusive, resulting in computational inefficiency.

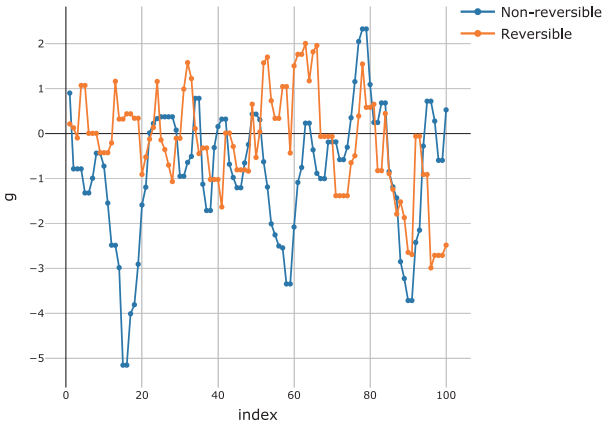


Figure 1: Random walk Metropolis algorithm (Orange), and Gustafson's algorithm (Blue).

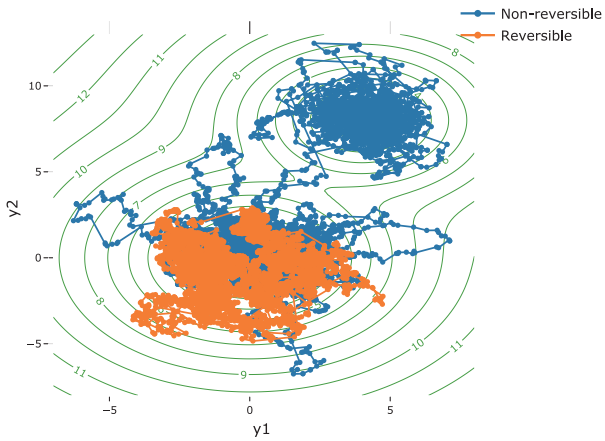


Figure 2: An MCMC with local balance (Orange), and a new global balance method (Blue).

■ Asymmetric MCMC method

One approach to avoid diffusive behaviour is to use a method that does not maintain local balance. Local balance is not a necessary condition for accurate quantification. Various cases have shown that methods that do not maintain local balance can improve convergence. However, designing an algorithm without local balance can be challenging because global relationships are harder to capture than local ones. One approach to make the design easier is to extend the state space and add a twist to the extended space. Horowitz's (1991) method, which added a twist to the Hamiltonian Monte Carlo method, is a representative example.

■ Lifting

Another approach is lifting, which assigns a global positive or negative direction to the flow. By doing this, a chain can go in one direction for a certain period of time. Although the local balance is not maintained due to the direction, two directions are taken with equal probability, resulting in overall global balance. Therefore, it is expected to contribute to better convergence by reducing the possibility of being trapped.

■ Guided walk

Gustafson's (1998) guided walk is a method that operates in a continuous state space (Figure 1). It is similar to the most basic MCMC algorithm, the random walk Metropolis algorithm, but has a direction and moves a number of times to the positive or negative. This method is effective in one dimension, but the positive and negative meanings are unclear in higher dimensions, and significant improvements in convergence cannot always be expected. However, if a more meaningful direction, such as moving closer or further away from the center, is selected, we may expect further improvements. We designed this scheme by using the Haar measure (Figure 2). Additionally, we are studying methods that use continuous-time Markov processes that do not maintain local balance, rather than discrete-time Markov chains.

■ Conclusion

Recent advancements in MCMC algorithms have made it possible to more practically apply statistical inference and machine learning to complex problems. However, as new types of datasets emerge, the design of these algorithms needs to keep up, making it a challenging and active area of research.

Kengo Kamatani

Longitudinal Data Analysis

■ Longitudinal data analysis

Data from multiple subjects, in which a response variable is measured repeatedly over time, are referred to as longitudinal data. We have proposed and extended "autoregressive linear mixed effects models", which combine autoregressive models, which regress a response to a previous response, and linear mixed effects models. The model incorporates differences in responsiveness to interventions and the effects of the previous covariate history, providing a unique variance-covariance structure. Similar models have been developed independently in multiple disciplines such as economics and sociology for different purposes. As links between disciplines have been established, the interrelationships have become increasingly clear. This will lead to further extensions and theoretical developments. We are also focusing on the interpretation of the model, such as unstable parameters showing short-term phenomena and parameter transformations facilitating interpretation. We aim to develop methods to represent the dynamics between variables measured over time.

■ Long-term indicators and prevention/countermeasures

We conduct research on phenomena with a long-time lag between variables. For example, early life experience may affect health in old age (Figure 1). There are growing expectations for data science, such as data-driven, evidence-based, and big data, but if the time lag is very long, important data are often not observed. It is also not clear whether the information from the observed generation can be extrapolated/projected to (the future of) a new generation with a very different historical background. Ideally, prevention/countermeasures should be available before we see bad outcomes. The research aim is to leave a more enriched society to the next generation and to develop a methodology for prevention/countermeasures.

■ Coronavirus disease 2019 (COVID-19)

Since the COVID-19 epidemic began, many researchers at the ISM have conducted various studies as countermeasures. A special issue of the Proceedings of the Institute of Statistical Mathematics has also been published. As many academic papers were published, some of them were difficult to interpret. The timing of infection is one such example, and a review paper on infectiousness was published. Excess deaths are also becoming difficult to interpret. Excess deaths are the difference between observed and expected deaths, but the observed low deaths in 2020 in Japan might make subsequent expected deaths to be lower than they should have been (Figure 2). Estimates of excess mortality based on international data have been different among leading research groups and some of the estimates were in conflict with observed deaths. We need to ensure robust indicators.

Ikuko Funatogawa

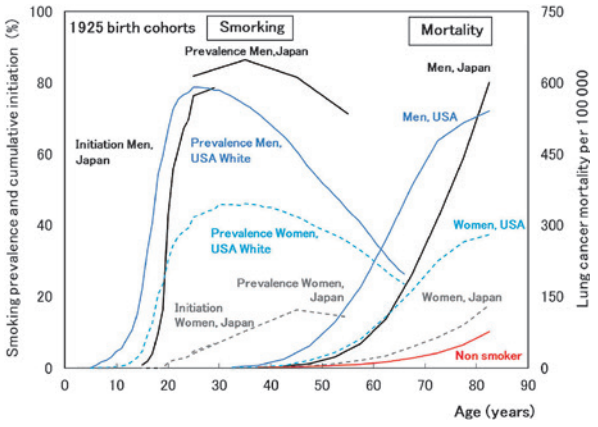


Figure 1: Cumulative smoking initiation, smoking prevalence, and lung cancer mortality according to age (1925 birth cohorts). Funatogawa et al. 2013 modified. Long-time lag between smoking initiation and lung cancer mortality.

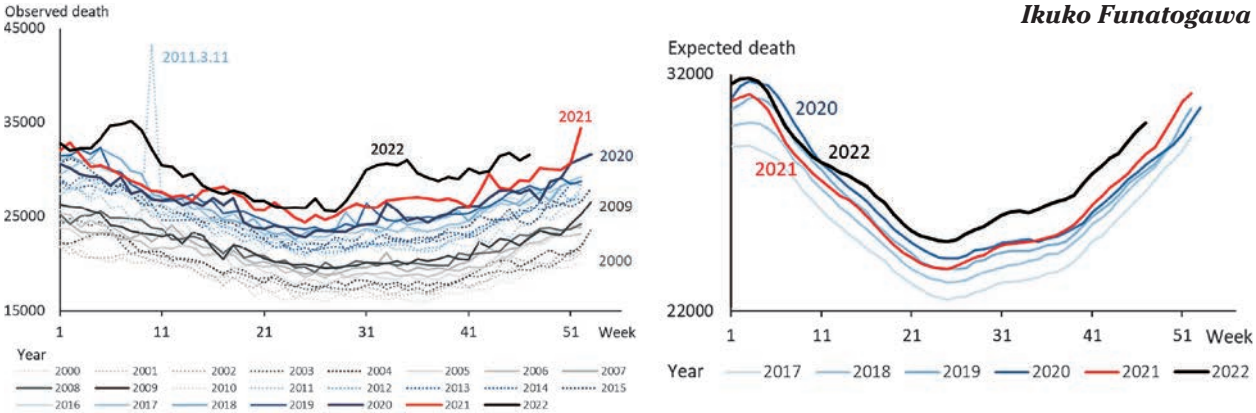


Figure 2: Weekly observed death 2000—2022 Japan (left) and weekly expected death 2017—2022 Japan (right). Based on exdeaths-japan.org. Expected deaths had been rising, but expected deaths in 2021 were lower.

Efficiency of the Invertible Function Estimation

■ The rise of image generation and machine learning technologies

By inputting few text words, desired images will be generated instantly —— I am sure that many of you have seen this technology at least once in social media these days. Such a model, which does not necessarily have to be limited to image generation, is called a "generative model," and has been studied roughly over the past 10 years.

■ The idea of a generative model

A brief description of the idea behind a generative model is shown in Fig. 1.

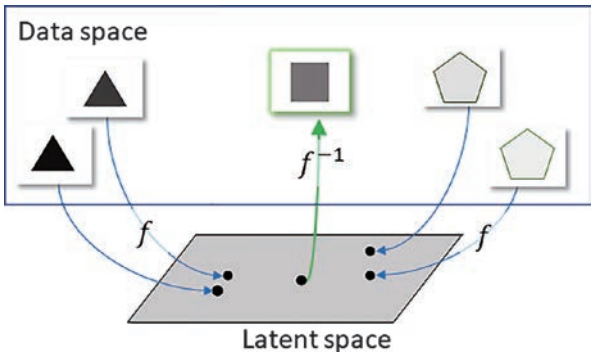


Figure 1: The idea behind a generative model.

Suppose we first learn the correspondence between the data space and a latent space. Then, we obtain points in the latent space, say, corresponding points of a triangle and a pentagon. If we take the average of the points obtained in the latent space, we can generate a data corresponding to the averaged point; we can expect to obtain the quadrangle whose property is also in between. Although we considered triangles and pentagons as examples here for simplicity, if we take the middle of the images of a black dog and a white dog, we can expect to generate an image of a gray dog. Applying this idea, we can generate any types of data as long as we can collect sufficient training data.

■ Invertible constraints in generative models

In the generative model described in Fig. 1, the correspondence between the data space and the latent space is learned and used. If, for example, a triangle corresponds to multiple points in the latent space, it becomes ambiguous which point should be used for taking the average. Therefore, the points in the data space must have a one-to-one correspondence with the points in the latent space, and the function that represents this one-to-one correspondence is specifically called an "invertible function". Therefore, learning the generative model can be regarded as estimating the invertible functions, going back and forth between data space and latent space.

■ Efficiency of the invertible function estimation

Since we have decided to use a special function called an invertible function, we can expect to estimate the function more efficiently than the estimation without any assumption. By mathematically evaluating how efficiently a function can be estimated, and by mathematically evaluating the limits of its efficiency, we can determine which methods have a room for improvement when learning a generative model, and which methods have already achieved the maximum efficiency. However, on the other hand, evaluating the estimation efficiency of invertible functions is difficult, and has been studied mainly only in the one-dimensional case, which is easy to prove.

In this research, in collaboration with Dr. Masaaki Imaizumi of the University of Tokyo, we derived a theoretical limit (minimax rate) for the efficiency of estimating invertible functions between two-dimensional data space and latent space, and proposed an estimator (Fig. 2) that achieves that limit. The paper is currently under review and a preprint has been uploaded online[*1].

The mathematical techniques used in this study can be used for the general case of more than 2 dimensions. We have already obtained partial results that extend the two-dimensional results to three and more general dimensions. We hope to publish these results in the near future.

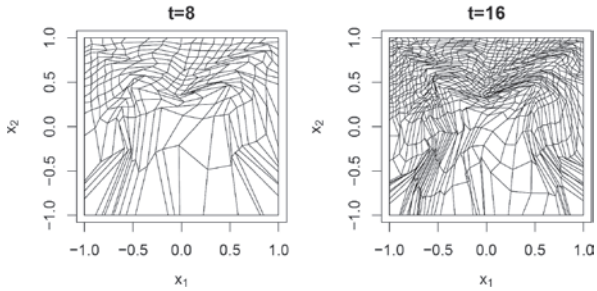


Figure 2: An approximation used in the proposed estimator.

Reference: *1 https://arxiv.org/abs/2112.00213.

Akifumi Okuno

Privacy Protection of Machine Learning Models with Partially Synthetic Data

■ Machine Learning as a Service (MLaaS)

In recent years, cloud service providers such as Google, Microsoft, and Amazon have provided customers with external APIs for machine learning models. Such Machine Learning as a Service (MLaaS) often employs machine learning models trained with personal data to support various tasks, including classification, prediction, and clustering. However, since the APIs of MLaaS are exposed to the public, there exist several possible attacks that cause the leakage of the training dataset of the model. In Figure 1, an attacker could conduct model inversion attacks that restore information on sample data, membership inference attacks that determines whether a target sample x belongs to the trained dataset D, or model extraction attacks that steals model parameters of the trained model.

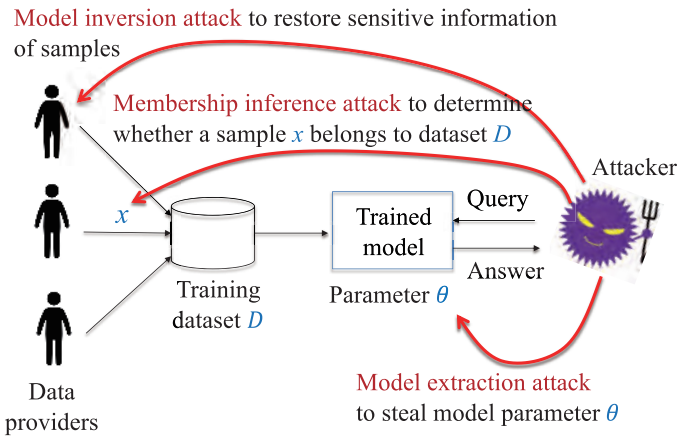


Figure 1: Inference attacks on sensitive personal data in a training dataset.

■ Membership inference attacks

We mainly focus on membership inference attacks that aim to infer membership, i.e., whether an individual belongs to a training dataset of the target model. Although membership inference attacks seem to be much less ambitious than model inversion attacks that restore sensitive attributes of samples, the risk of the former is significant when all the individuals in the dataset share the common sensitive attribute, such as a medical database of a particular disease, because the disclosure of the fact that an individual belongs to the training set implies the leakage of the individual's sensitive attribute values. Also, previous research shows that membership inference attacks exploiting black-box access to a target model is feasible.

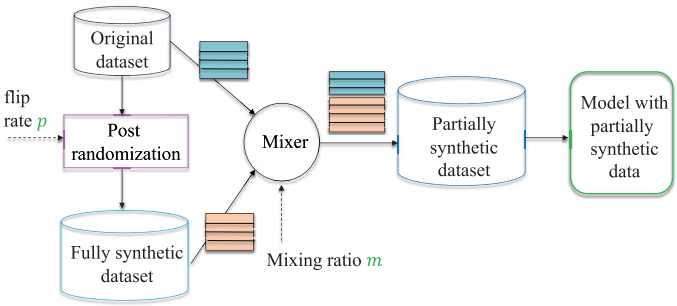


Figure 2: Process of constructing a model with a partially synthetic dataset.

■ Membership inference countermeasure with partially synthetic data

Existing countermeasures against membership inference attacks include differential privacy, confidence score masking, and regularization. However, those methods suffer either from insufficient resistance to the attack or the degradation of model utility. We, therefore, explore the approach of partially mixing synthetic data to the original data to achieve the model's resistance to membership inference attacks while retaining the prediction accuracy of the trained model. Figure 2 shows the process of generating a model using a partially synthetic data. We combine records from an original dataset with those from a synthetic data dataset prepared with the post randomization method (PRAM) of flipping original record values with a given flipping rate p. By conducting experiments with the dataset of Purchase 100, we find that the practical strategy of turning two parameters for producing partially perturbed datasets; that is, we should first set the mixing ratio m of synthetic data high such that we can take an adequate balance between the attack resistance and the model's prediction accuracy by controlling the flip rate p of the post randomization method.

Reference: Wakana Maeda, Yuji Higuchi, Kazuhiro Minami, Ikuya Morikawa. Membership Inference Countermeasure With a Partially Synthetic Data Approach. The 4th International Conference on Data Intelligence and Security. August, 2022.

Kazuhiro Minami

Crystal Structure Prediction Using Surrogate Model Based Virtual Screening

■ Crystal structure prediction problem

A crystalline solid is a state where molecules and atoms are arranged and formed in infinite space with a certain periodicity. Since crystal structure significantly impacts the physical properties and functions of materials, crystal structure prediction is considered a fundamental research issue in academia and industrial needs.

The problem of crystal structure prediction (CSP) has been studied for over 20 years. Crystal structure prediction by conventional experimental methods is time-consuming and costly. With the development of machine learning, a broad array of CSP methods has been developed to date. However, various issues still need to be solved, such as the prediction accuracy of machine learning models and computational costs. There are strong expectations from materials exploration, drug design, and energy conversion for solving crystal structure prediction problems. Against this background, our group is collaborating with companies to develop a new method to solve the crystal structure prediction problem fundamentally.

■ Crystal structure prediction using surrogate models

CSP aims to propose a stable crystal structure of a target compound based solely on its chemical formula. That means the crystal structures are deduced from the given chemical formula, then evaluate the formation energy to distinguish the stable structures. Structures with relatively low energy are assumed to be stable. Therefore, developing an efficient crystal structure generator and a method to evaluate the formation energy with high accuracy and speed are the keys to solving the CSP problem. For crystal structure generation, we have trained models that predict information such as space groups, symmetry, and similarity of stable structures from the chemical formula and developed three types of structure generators to consume the predicted information. We trained the surrogate model to predict the formation energies of generated structures and introduced a technique called transfer learning to improve the accuracy of the model for prediction on roughly generated structures.

We tested the performance of our approach on 35 selected benchmarks with diversity, complexity, and practical applicability kept in mind. Our proposed methods achieve a minimum accuracy rate of 48.6% and a maximum accuracy rate of 91.4%, compared to the accuracy rates of mainstream structure prediction methods (e.g., USPEX).

■ Towards the discovery of innovative materials

Innovative materials only exist outside the periphery of known data. Although our approach has shown surprisingly high correctness on the existing data, "How useful can we be in discovering unknown substances?" the question remains unknown. Furthermore, if we can predict the crystal structure, reasonable chemical formula, and synthesizability, and can build a system that seamlessly integrates all these predictors. We will surely bring great innovation into the fields such as functional materials and pharmaceuticals. In addition, analyzing information such as crystallization conditions, polymorphism, and physical, optical, and electromagnetic properties from newly discovered materials can provide various benefits for academics and industry. Therefore, polishing and automating our approach will significantly increase the efficiency of novel materials discovery.

Chang Liu

Composition	Space group-aware	Metric learning based	Template based	USPEX
Ag_6GeS_6	-	-	✔	-
Al_2O_3	✔	✔	✔	✔
BN	-	-	✔	-
$Ba(FeAs)_2$	-	✔	✔	✔
Bi_2Te_3	✔	✔	✔	-
C	✔	-	✔	-
$Ca_{14}MnSb_{11}$	-	✔	✔	-
$CaCO_3$	✔	✔	✔	✔
Cd_3As_2	✔	✔	✔	-
$CoSb_3$	✔	✔	✔	-
$CsPbI_3$	-	✔	✔	-
$Cu_{12}Sb_4S_{13}$	✔	✔	✔	-
Fe_3O_4	-	-	✔	-
GaAs	✔	✔	✔	✔
GeH_4	-	-	✔	-
La_2CuO_4	-	✔	✔	-
Li_3PS_4	-	-	-	-
$Li_4Ti_5O_{12}$	-	-	✔	-

Composition	Space group-aware	Metric learning based	Template based	USPEX
$LiBF_4$	-	-	✔	✔
$LiCoO_2$	-	-	✔	-
$LiFePO_4$	✔	✔	✔	-
$LiPF_6$	✔	✔	✔	✔
$Mn(FeO_2)_2$	✔	✔	✔	✔
Si	✔	-	✔	✔
Si_3N_4	-	-	✔	✔
SiO_2	-	-	-	-
$SrTiO_3$	✔	✔	✔	-
TiO_2	-	-	-	✔
V_2O_5	-	-	✔	-
VO_2	✔	✔	✔	✔
$Y_3Al_5O_{12}$	✔	✔	✔	-
ZnO	✔	✔	✔	✔
ZnSb	✔	✔	✔	✔
ZrO_2	-	✔	✔	-
$ZrTe_5$	-	✔	✔	-
Overall	17/35 = 48.6%	21/35 = 60%	31/35 = 91.4%	13/35 = 37.1%

Figure 2: Correctness between different methods on 35 benchmarks.

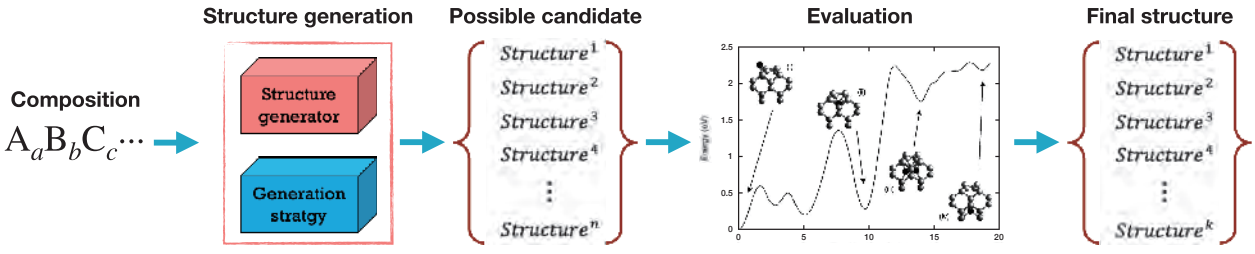


Figure 1: A typical workflow of CSP.

Creation of Polymer Properties Database Using Automated Molecular Dynamics Simulation

■ Understanding and discovery of thermally conductive polymers

Organic polymers are materials with huge molecular weight, and have unique characteristics of lightness, ease of processing, and flexibility. On the other hand, due to the vast parameter space of material design, it is required to establish efficient material exploration methods for further functionalization. The goal of our research is to discover polymeric materials with innovative properties. Our group is participating in the JST-CREST Nano-enabled Thermal Management from 2019, and was granted for the MEXT "Program for Promoting Researches on the Supercomputer Fugaku" in 2021.

■ Machine learning technologies for automated molecular design

We applied a machine learning to the polymer database PoLyInfo to design high thermal conductive polymers. For thermal conductivity of amorphous polymers, only 28 samples were recorded at the database. To overcome the difficulty of the limited data, we applied a transfer learning to obtain a predictive model of thermal conductivity. By solving its inverse problem, we created a virtual library of 1,000 candidate polymers with high thermal conductivity. From this library, we synthesized three new polymers with a thermal conductivity of 0.41 W/mK. This correspoznds to an improvement of 80% compared to commonly used amorphous polymers.

■ Lack of open data for data-driven research

The amount of data in materials research is much less than in other applied fields of data science. There are three main reasons for this: (1) the high cost of data production; (2) the difficulty of creating common data due to the diversity of researchers' needs; and (3) the prevention of information leakage to competitors. In particular, PoLyInfo is the only polymer database that can be used in data-driven research.

■ Creation of polymer property database with automated molecular dynamics simulation

We developed a high-throughput calculation system for automated molecular dynamics simulation of polymer properties. We organize an industry-academia consortium with ISM, three universities, and 25 companies and we are creating a polymer properties database using this automatic system. Our ultimate goal is to build a database that covers various properties for more than 100,000 polymers. For example, we will be able to comprehensively study polymer structures located at the Pareto boundaries between properties, and may discover unique molecular skeletons that cross the Pareto boundaries. We will accomplish this mission as a joint research project under industry-academia partnerships.

Yoshihiro Hayashi

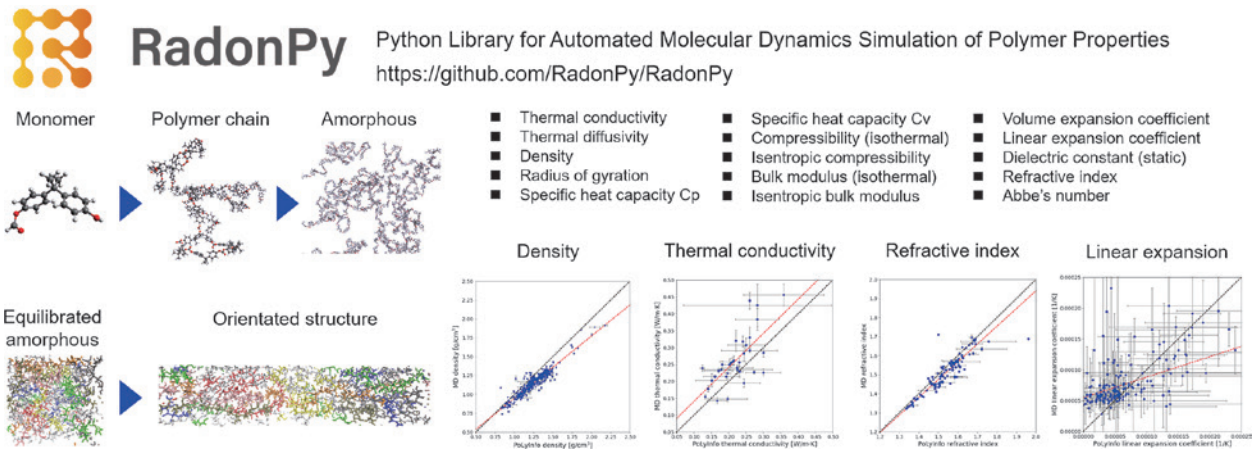


Figure: Automated calculation of polymer properties using molecular dynamics simulation.

Pursuing the Advancement of Medical and Health Data Science

■ Medical and health data science and the center's mission

In recent years, expectations regarding data science have been growing in various fields, including medical and health sciences. These days, the application of deep learning and other cutting-edge AI technologies to the analysis of molecular/medical big data is widely expected to sharply accelerate the elucidation of biological and disease mechanisms, the development of medical technologies, including drug discovery, and the realization of precision medicine. In the meantime, we should not forget the critical role of obtaining solid evidence on medical technology from high-quality small data derived through careful study design and statistical inference. While it is considered that expectations regarding medical and health data science will continue to grow, the framework of data science has yet to be established to fully meet such expectations; hence there is a big gap to be filled. That is to say, the enhancement of education and research in medical and health data science is our great challenge for the future.

e-learning website.

The 15th Oxford Conference on Modelling and Control of Breathing (2022.10).

The Research Center for Medical and Health Data Science was established in April 2018 based on research and researcher education in data science and on the network of Japanese and foreign researchers that the Institute of Statistical Mathematics has established over many years. The Center's mission is to promote projects that enhance education and research in medical and health data science in Japan. The Center has been in existence for five years, it has been involved in a variety of educational and research activities thus far.

■ Educational and research activities

In the area of education, the Center has been promoting the development of various educational programs, such as systematic education courses on theories and methods of statistical mathematics, biostatistics, theoretical epidemiology, and machine learning, topics that form the basis of medical and health data science. In addition, the Center has focused on open lectures, as well as the development of e-learning materials to be shared with the research community.

In the research sector, the Center has been actively working on a variety of projects, such as those involving statistical methodologies pertaining to advances in medical technology and healthcare, as well as research in public health and social medicine. Additionally, the Center is involved in big data analysis using cutting-edge machine learning and AI algorithms, and is performing studies on foundational mathematics and computer technologies.

■ Medical and Health Data Science Research Network

All of the above projects are linked with the activities of the newly launched "Medical and Health Data Science Research Network." This unique network comprises 100 organizations (as of February 2023), including related academic societies, universities, and research institutions in all parts of Japan, as well as hospitals and companies. The substantial advancement of medical and health data science depends on the organic collaboration of researchers in the fields of statistical mathematics and information science and those in the fields of medical and health science. The Center intends to make every possible effort to play an important part in bridging these fields.

Shigeyuki Matsui

Increased Suicide Rates in COVID-19 Outbreak —Understanding Regional and Gender Differences

■ Suicide rate change during the corona disaster

Suicide in Japan, which had been decreasing for 11 years since 2009, began to increase in 2020. The increase in the suicide rate among women was particularly pronounced. In this study, in order to understand regional and gender differences in the rise in the suicide rate in the corona epidemic, we created an index, "degree of rise in suicide rate," which represents the highs and lows of the rise in the suicide rate. We do not discuss the formula here, but it is a value that indicates how large/small the increase in the suicide rate was for each municipality relative to the degree of increase in the national suicide rate after the corona. Panel data were constructed for 1,735 municipalities.

■ Industrial structure and rising suicide rates

The official statistics and data on 14 major industries were concatenated with the aforementioned panel data. The results showed a significant positive correlation between the suicide rate increase and the employment rate in the domestic demand-oriented service industry. Only the employment rate for males was significantly higher in the manufacturing industry, while the rate for females was higher in the accommodation and food services industry. When the municipalities with the top 100 employment rates in these industries were selected for analysis, it became clear that the variation in the degree of increase in the suicide rate for women in relation to the accommodation and food services industry was very large (Figure 1).

The relationship between the employment rate by industry and the increase in the suicide rate in 35 municipalities in Shizuoka Prefecture was analyzed and mapped (Figure 2). Eight of the 11 municipalities with particularly high increases in the suicide rate among women were concentrated in the Izu Peninsula, which has a high employment rate in accommodation and food services.

■ Why did the suicide rate among women rise?

The accommodation and food services was one of the hardest hit industries by the Corona disaster. This industry is characterized by a high percentage of women in the workforce and a prominently high percentage of non-regular employees among the 14 major industries. It is highly likely that female employees were the first to be targeted in workforce reductions to avoid bankruptcy, suggesting that this industrial structure and employment pattern may have been more strongly affected by the economic crisis and increased the risk of suicide among women.

Mayumi Oka

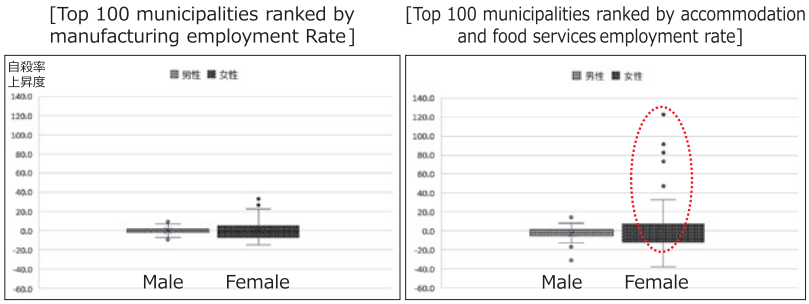


Figure 1: Rise in Suicide Rates in the Top 100 Municipalities with Employment in the Manufacturing and accommodation and food services.

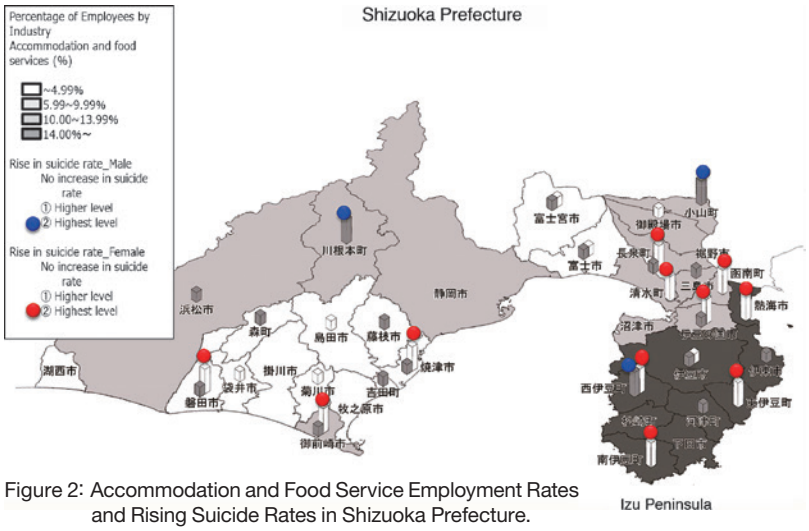


Figure 2: Accommodation and Food Service Employment Rates and Rising Suicide Rates in Shizuoka Prefecture.

A Novel Phylogenetic Method for a Macroevolutionary Model of Phenotypic Traits.

■ Significance of trait data

In evolutionary biology, much effort is paid to understanding why the organism obtained its current forms and how ancestral species have diverged. In particular, molecular phylogenetic methods, which infer past phylogenetic trees from the current molecular sequence data such as DNA, originated in the Institute of Statistical Mathematics and now are applied to various research projects. But, effective methodologies are also desired for a trait. These kinds of methodologies are called "phylogenetic comparative methods" (PCMs). PCMs are suited to study which factors drive a specific trait (e.g. the size or shape of a particular organ, or behavior data) and to adjust autocorrelation due to the shared evolutionary history in a multi-species regression analysis.

■ A dilemma of PCMs

Previous PCMs, however, have faced a dilemma between mathematically tractable but restrictive approaches (Gaussian-Process models) and flexible but intractable approaches (a simulation-based process model of phenotype evolution built on population genetics frameworks). Gaussian Process PCMs are faster and more efficient. But, its mathematical structure sometimes requires unrealistic biological assumptions, which render the interpretation of estimated parameters difficult. A simulation-based PCMs, in contrast, allow more flexible and realistic modeling which brings interpretable parameters. But, its exact likelihood function is not known and thus demands quite a slower computational algorithm called approximate Bayesian computation (ABC). Its statistical properties (e.g. bias, and Frequentist coverage properties of the credible interval) were also questionable.

■ Proposed method

I proposed a novel branch-specific directional selection model (BSDS) to reconcile these two approaches (Ohkubo et al. 2023: Evolution). This methodology is based on the fact that the previous simulation-based model can be approximated up to the 2nd order and that, though the full-likelihood function is not available, a pseudo-likelihood function can be obtained without any explicit simulations. The proposed method is faster than the previous method of ABC, as well as it achieves better statistical performance. Extension to a multivariate trait model and the construction of a model selection procedure would be a future project.

Yusaku Ohkubo

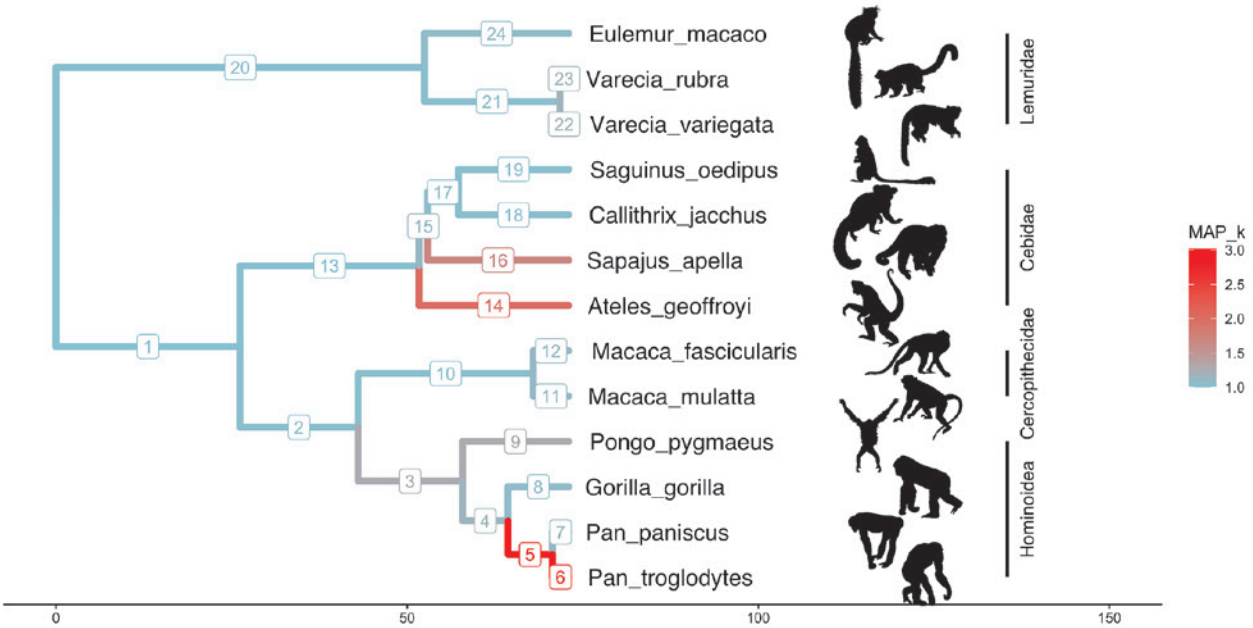


Figure: An example of the empirical application of BSDS. We analyzed 13 species of apes to estimate the evolution of maximum waiting time for delayed rewards.

“Giri ninjō” and “Kurashi-Kata” in the Heisei Era: from the Surveys on the Japanese National Character

■ The Japanese National Character in the Heisei era

The Institute of Statistical Mathematics (ISM) has conducted a nationwide survey every five years since 1953. The 15th nationwide survey will be conducted in the fall of 2023; the 70th anniversary of the start of the survey. We wanted to assess the values and attitudes of the Japanese people based on data from the 9th (1998) to 14th (2018) waves of the Surveys on the Japanese National Character so as to reflect the Japanese consciousness during the Heisei era, focusing on the survey’s long-term, continuous items “Giri ninjō” and “kurashi-kata”.

■ “Giri ninjō” and “kurashi-kata” as the survey’s long-term, continuous items

Looking at the responses to the “Giri ninjō” item, it was confirmed that “Giri ninjō” relationships were still favoured in the Heisei period as you can see in fig.1.

The periods of the survey that reveal similar distributions are (1998, 2003), (2008, 2013), and (2018), with 2008 and 2013 showing close results to 1988. The values that decreased from 1993 to 1998 in the early Heisei period rose in the following three surveys starting in 2003. In other words, it was expected that the values on the “Giri ninjō” scale in the Showa period would not be high and that the values on the “Giri ninjō” scale in the Heisei period would continue to decrease. However, the 2008 and 2013 surveys show a return to the high values of the 1988 level.

In addition, looking at the responses to the “kurashi-kata” item, the most notable decrease in Fig. 2 is observed for “resist all evils in the world and live a pure and just life”. On the other hand, especially in the Showa period, two response options, “do not think about money or fame; just live a life that suits your taste” and “live each day as it comes, cheerfully and without worrying”, increased. The former became the most common opinion as early as 1958. These two options remained the most common during the Heisei period, and this indicates that Japanese people in the Heisei period placed importance on enjoying the things around them and in their daily lives.

Japan in the Heisei era was a time of reform and change in all aspects of society, from the bursting of the economic bubble to the global recession, including the collapse of Lehman Brothers and the Great East Japan Earthquake. In order to clarify the Sense of “Giri ninjō” and “Kurashi-Kata” properly, it is necessary to consider expanding the model to include the economic growth rate and other objective variables while considering generational and historical factors. Furthermore, we are planning to conduct cross-cultural research on the national character including international comparison, so as to capture the Japanese National Character over a wide range and in various contexts.

Yoosung Park

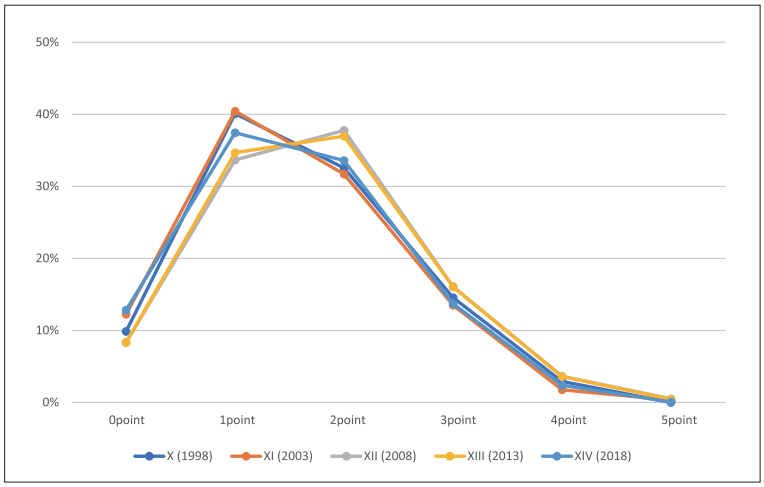


Figure 1: Variation in the values of the “Giri ninjō” scale during the Heisei era.

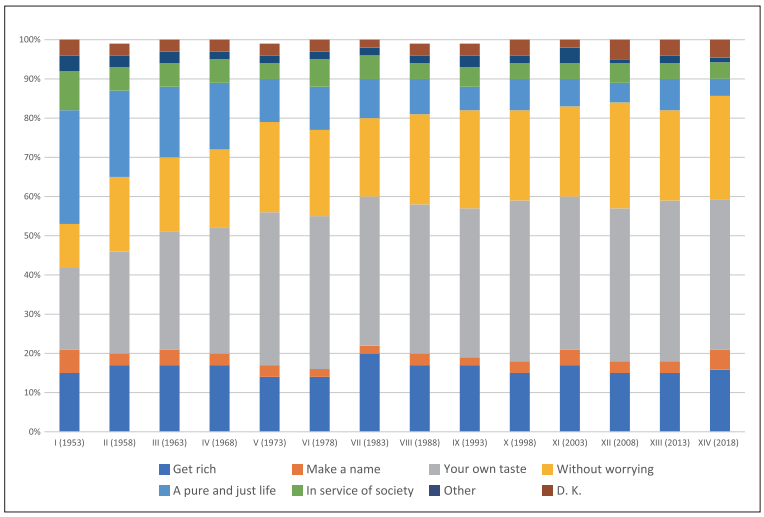


Figure 2: Variation in the distribution of answers to the “kurashi-kata” (attitudes towards life) question from the first to the fourteenth survey.

For Promoting Interdisciplinary Research and for Solving Social Problems with Industry-Academia-Government Collaborations

■ Research and Educational Activities as a Biaxial Structure

The Institute of Statistical Mathematics (ISM) pursues research and education in the own biaxial structure; one is structured by three basic research departments and the other is by NOE-type research centers and organizations for professional development. By its nature, the basic research departments cut across and link various disciplines, with the goal of developing tools for interdisciplinary research. The field of statistical mathematical sciences must itself evolve to meet the changing needs of society and the data environment, and is therefore constantly evolving as a field of study. At the same time, there are approaches and directions that have remained unchanged as the field evolves. There are three basic research departments: Statistical Modeling, Statistical Data Science, and Statistical Inference and Mathematics. These departments engage in cutting edge research aimed at developing methodologies for rational prediction and decision making, based on data and existing knowledge. We regularly assess whether our research system is functioning effectively from the viewpoints of research trends and prospects in statistical mathematical sciences. Basically, all faculty professors belong one of these three departments.

On the other hand, NOE-type research centers and organizations for professional development are staffed by affiliated faculty professors, project professors/researchers (post-doctoral researchers), and visiting professors and researchers. There are four NOE-type research centers: the Risk Analysis Research Center, the Research Center for Statistical Machine Learning, the Data Science Center for Creative Design and Manufacturing, and the Research Center for Medical and Health Data Science. These centers conduct research activities at the interface of statistical mathematical sciences and individual scientific disciplines to find solutions to urgent social problems. Researchers are able to join the activities in the center flexibly.

In addition, two organizations are committed to professional development. The School of Statistical Thinking, is the base for the Project for Fostering and Promoting Statistical Thinking and provides various programs. The Center for Training Professors in Statistics is to promoting the Project for Training Experts in Statistical Sciences. This center trains statistics professors and experts in statistical sciences, primarily through graduate school education, and develop the statistical education system. For more details, please see each project's page.

■ NOE Project

In accordance with the second medium-term plan for the Research Organization of Information and Systems (ROIS, ISM's parent organization), ISM had set as

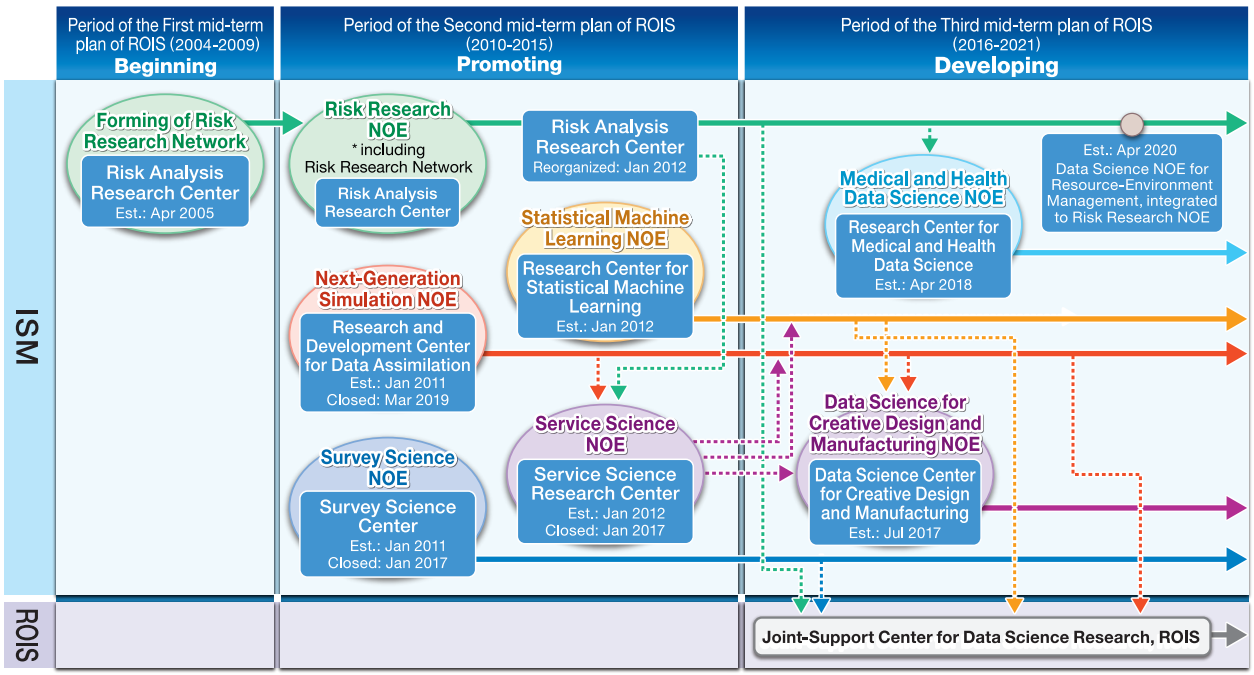


Fig. 1: Brief history of NOE Project.

a goal the establishment of NOE (Network Of Excellence) in statistical mathematics. Initially, ISM established NOE in Risk Research, Next-Generation Simulation, Survey Science, Statistical Machine Learning, and Service Science. ISM reviews organizations of the project regularly, and ISM reorganized the NOE-type Research Centers in the past few years, considering the needs of each community as well as modern society as a whole (Fig.1). There are six NOE today in the fields of Risk Research, Next-Generation Simulation, Survey Science, Statistical Machine Learning, Data Science for Creative Design, and Medical and Health Data Science, which promotes research and educational activities including cooperation with the Joint-Support Center for Data Science Research, ROIS.

ISM has set the goal for this NOE Project which is importance to fulfill the goal of establishing new scientific methodologies ("Fourth Paradigm: Data Science") in a knowledge-based society, in which the importance of knowledge goes beyond merely solving individual problems, the NOE activities are being systematically pursued under the unified guidelines formulated by the Managing Committee of the NOE Project. We also commission experts from the industrial, academic, and government sectors to be members of the Advisory Board of the NOE Project, and their advice helps us to promote the project much more effectively (Fig. 2).

The number of Memoranda of Understanding (MOUs) with research organizations within Japan and overseas, which are conducted by NOE-type research centers, is increasing in each year. Particularly, academic exchanges encompassing multiple NOE domains provide significant opportunities to integrate different research fields and create new ones. ISM provides flexibility for research and contributes to society. Consequently, ISM's general research in statistical mathematical sciences is highly demanded by various research fields in both the humanities and sciences. Recent reorganizations at ISM have deepened and promoted the NOE Project.

In the fourth medium-term plan for six years of ROIS, which began in April 2022 (and continues until March 2028), ISM set the goals; to promote the development of cutting-edge mathematical techniques, to promote industry-academia-government collaborations, to enhance relations with other research organizations and to increase NOE-type MOUs. For that, ISM will reorganize NOE-type research centers. Centers will be classified into methological and domain type. Members at ISM have many discussions for much better research and educational activities with the point of views in current and future, and ISM will reorganize both basic research departments and NOE-type research centers in this fiscal year to accelerate cutting-edge research and collaboration research.

ISM is continuously expanding and developing this NOE project with the aim of establishing new scientific methodologies, interdisciplinary research, creating new research disciplines, industry-academia-government collaboration and so on. For up-to-date information, please visit the website. We truly appreciate your understanding and support for this project.

https://www.ism.ac.jp/noe/project/en/

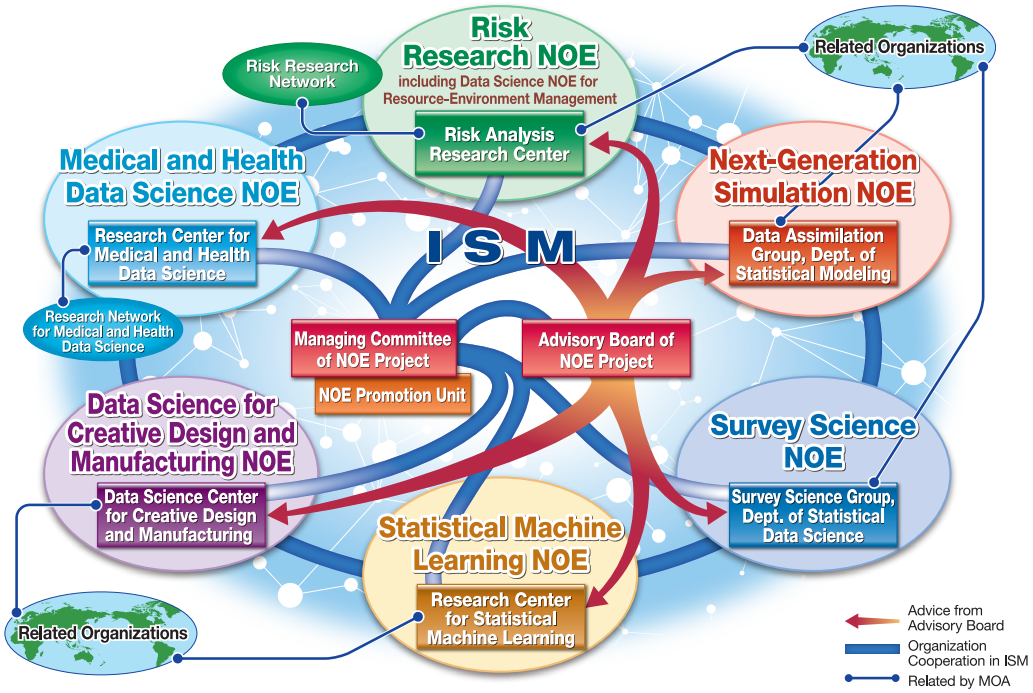


Fig. 2: Relationship Diagram of NOE Project.

Project for Fostering and Promoting Statistical Thinking

Rapid development of information and communication technology has led to the explosion of data. Now surrounded by “Big Data”, everybody is expected to “think statistically”. More than ever, there is a need for data scientists who can handle such big data and are able to extract useful knowledge from it. Meanwhile, Japanese higher education is exhibiting a deplorable lack of production capacity in terms of data scientists. This can be accounted for by the fact that, until quite recently, no academic institution other than ISM had a Ph. D. course in statistics and the small number of statisticians in academia are isolated from each other, being scattered over various disciplines. Hoping to gain a little traction on this problem, ISM established the School of Statistical Thinking, into which we integrated all of our educational resources. In FY 2016, ISM established the Managing Committee of School of Statistical Thinking, inviting contributions from outside experts, and in FY 2017 we launched the Leading DAT program by adopting the suggestions by the committee. In FY 2020, we launched online courses. The following are the principal projects.

Research Collaboration Startup

The Institute had already been providing a consultation service for statistical science, but along with the launch of the School of Statistical Thinking in November 2011, this service was reorganized as a research collaboration startup. This program, being one of the projects to foster and promote statistical thinking, is mainly aimed at supporting applied scientists and other non-experts. Expert statisticians affiliated with the Institute give them advice on statistical modeling, data analysis, and research. Some cases have developed into official research collaborations, which are our primary duty as an inter-university research institute. The Institute accepts around 25 cases annually, some of which benefit society in diverse ways.

Data Science Research Plaza

Researchers funded by private-sector firms can maintain a desk and phone in the School of Statistical Thinking. This program is subject to fees, and the contract can be renewed annually. A faculty mentor gives advice to the accepted funded researcher so that he or she can freely attend various events, such as seminars, workshops, conferences, and extension courses. After learning the expertise of the ISM research staff, participants in this program are invited to take advantage of paid consultations and funded research collaboration.

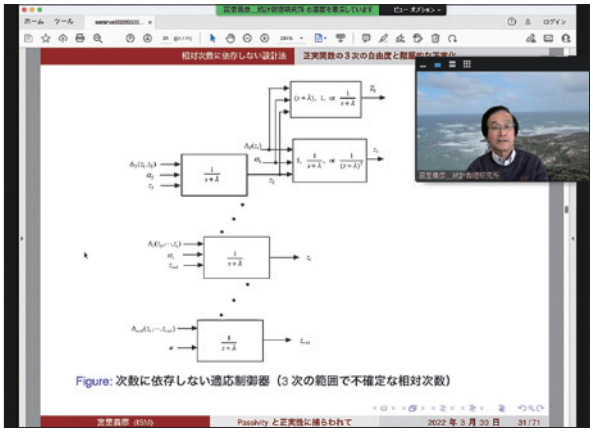
Open-type Professional Development Program

This is a spin-out program from ISM cooperative research projects. Establishing a goal is an indispensable element of the proposal of a cooperative research project. On the other hand, such goal setting is irrelevant for a summer school program, study session, or retreat. Since the launch of the School of Statistical Thinking, organizers of such group-oriented study programs can apply to the Open-type Professional Development Program. There are two categories under this program: one is ‘workshop’ and the other is ‘intensive training for young researchers’. For FY 2022, nine workshops have been accepted after review.

Statistical Mathematics Seminar Series

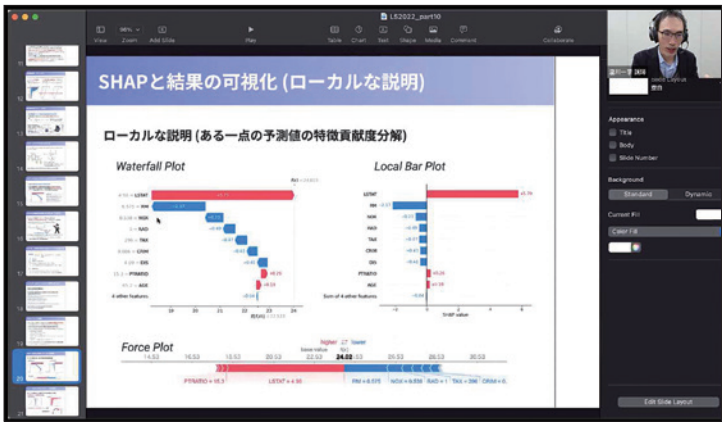
The Institute holds weekly seminar series on statistical mathematics every Wednesday. The seminars are led by in-house and external lecturers to showcase their latest studies. These lectures are currently held online. To view the seminar schedule and learn more about the program, please visit the Institute of Statistical Mathematics website.

https://www.ism.ac.jp/index_e.html



Leading DAT

In FY 2017, the School of Statistical Thinking launched a program called “Leading DAT” aimed at training data scientists with the knowledge and skills in statistical mathematics required by modern society. In FY 2022, we held four Leading DAT lectures and three Leading DAT free lectures online, entitled “L-A. Basics of Modern Statistics”, “L-B. An Introduction to Statistical Modeling”, “L-S1. Basics and Practice of Decision Trees and Ensemble Learning”, “L-S2. Statistical Causal Effect Estimation and its Applications”, and “L-X1. Introduction to Graphical Models (1)-How to read and write graphs”, “L-X2. Introduction to Graphical Models (2)- Graphs and Probabilistic Inference”, “L-Y1. Introduction to Time Series Analysis of Point Processes”. Additionally, lecture videos and supporting videos for the first two days of the 2021 L-A course are now available on YouTube free of charge.



Online course (L-S1)

Tutorial Courses

The education program at ISM dates back to 1944, the year of founding. The Ministry of Education installed a training center within ISM to foster technicians in numerical computation. After the World War II, this training center was relaunched in 1947 to develop pollsters and census takers. It helped to cultivate professionals in the field of statistical surveys, while a growing number of entries from business and industry coming for various types of training were also observed.

Now the tutorial courses are operated by the School of Statistical Thinking, which was established in 2011.

In FY 2022, 9 lectures were held and the number of participants was 1,029. The total numbers of lectures and courses held from 1969 to March, 2023 were 401 and 5 respectively, with a total of 29,913 participants. These lectures covered a wide range of fields from basic to applied statistics. The schedule of tutorial courses can be found on the website of the Institute of Statistical Mathematics.

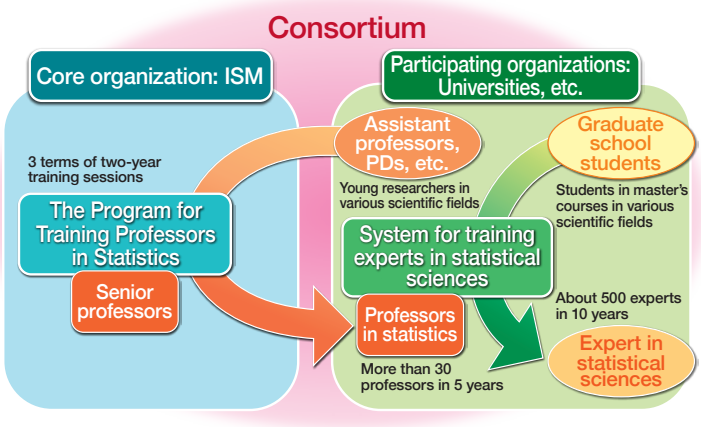
https://www.ism.ac.jp/lectures/kouza.html

Project for Training Experts in Statistical Sciences

Many universities have recently established data science departments and faculties. This has led to a shortage of expert faculty members in statistics, which are the core of data science. To address this issue, the Institute of Statistical Mathematics (ISM) has launched the "Project for Training Experts in Statistical Sciences" with the support of the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

In this pioneering project, ISM trains young researchers in various academic fields at universities and research institutes across Japan to become "professors in statistics". These professors in statistics will give lectures on statistics, which is the foundation of data analysis, to master students of graduate schools and supervise academic research using statistics, which will develop "experts in statistical sciences" at universities and research institutes nationwide. Then these experts will leverage statistics to contribute to academic research and industrial promotion.

The goal of the project is to establish a virtuous cycle of professional development in the field of statistics. This project strives to develop at least 30 professors in statistics over the 5-year project period and to train approximately 500 experts in statistical sciences over a 10-year period, including the project period.



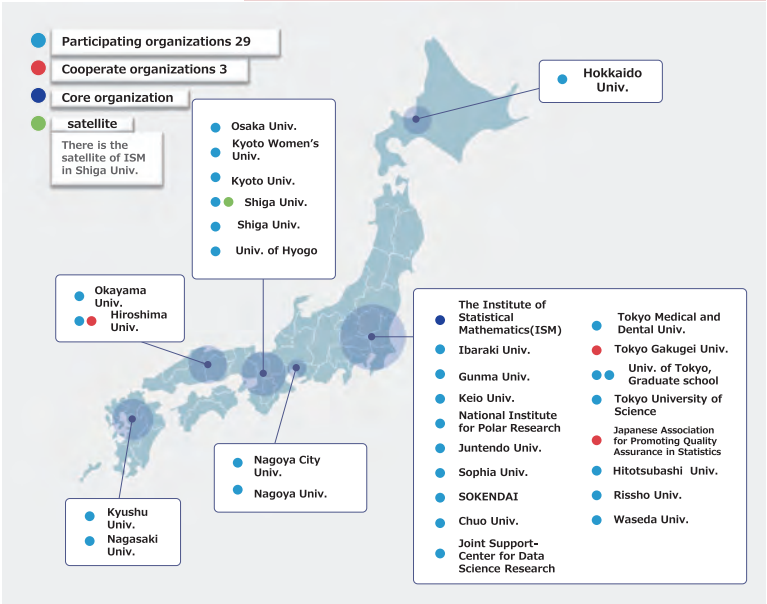
Project framework.

■ Consortium for Training Experts in Statistical Sciences

In August 2021, ISM established the "Consortium for Training Experts in Statistical Sciences" to promote the project in cooperation and collaboration with universities and research institutes nationwide. The Consortium consists of the core organization, participating organizations, and cooperating organizations. At the core of the Consortium is ISM. Universities and research institutes nationwide are either cooperating organizations if they participate in the development of education programs or participating organizations. When the Consortium was established, there were 21 participating organizations. Today there are 29 participating organizations.

In January 2022, ISM established the "Center for Training Professors in Statistics" as an official internal organization to ensure smooth operation of the Consortium. ISM also established a satellite at Shiga University as a base for training in western Japan.

The number of participating institutions has expanded **from 21** at the time of establishment **to 29 in two years**



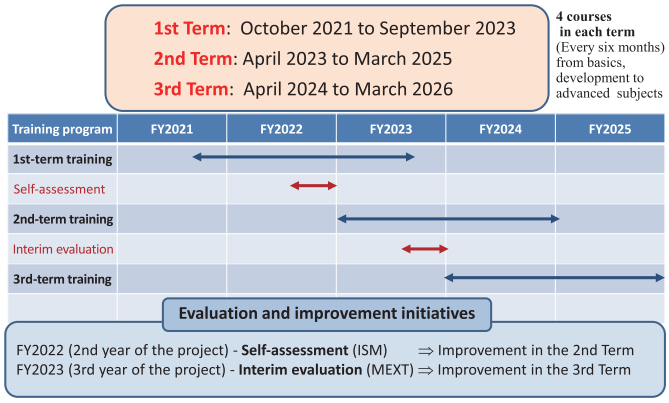
Members of Consortium for training experts in Statistical Sciences.

■ Statistics Professors Training Program

ISM provides the "Statistics Professors Training Program", which is a two-year program to train young researchers in various academic fields at universities and research institutes nationwide to become professors in statistics. The program is to support three cohorts. The first cohort, which started in October 2021, involved 6 senior professors training 12 young

researchers. The second cohort, which started in April 2023, included 8 senior professors training 13 young researchers. The third cohort should commence in April 2024.

The program aims to improve the trainees' knowledge of statistics, strengthen their ability to give lectures on statistics, and enhance their skills to conduct academic research using statistics. To improve teaching abilities, trainees repeatedly give "mock lectures" in which they take on the role of a teacher and lecture on various statistics topics to accumulate experience. Additionally, trainees attend lectures in advanced data science areas such as statistical causal inference and acquire knowledge about programming languages such as Python and R.



The Program for Training Professors in Statistics – Schedule.

The goal of training is not to develop "statisticians" majoring in statistics. Instead, the program strives to develop university faculty members who can educate students on statistics and supervise academic research using statistics while respecting the trainees' academic fields of specialization such as engineering, medicine, pharmacy, economics, and literature.

■ Workshop and Presentation of Trainees' Achievements

Each year, the Consortium holds a "Workshop for the Development of Statistical Experts Training System". Here, trends in statistics education in other countries and the status of the development of statistics education programs at leading universities in Japan are shared to help universities and research institutes develop experts in statistical sciences. In 2022, the Consortium also hosted an invited lecture series by prominent overseas researchers in the fields of statistics and data science education.

Trainees of the Statistics Professors Training Program present their research results based on the skills they have refined through the program at various academic conferences such as the Japanese Joint Statistical Meeting organized by the Japanese Federation of Statistical Science Associations, and the Interim Professional Development Report Meeting organized by ISM.

■ Self-assessments

In FY2022, which was the second year of the project, the Consortium conducted a self-assessment on the progress and effectiveness of the efforts in the initial phase of the project. For the self-assessment, ISM implemented a questionnaire survey of all consortium member organizations and trainees to obtain diverse perspectives and requests regarding the consortium activities. In addition, a "Self-assessment Advisory Board", which consists of experts in statistics, was established to provide advice and recommendations. In February 2023, the Consortium released a "Self-assessment Report" on its website. In response to issues identified in the assessment, the Consortium will improve its initiatives such as the Statistics Professors Training Program and consortium management.

■ Initiatives of Consortium Participating Organizations

The actual situation of statistics education at consortium participating organizations is diverse. Some have established graduate schools of data science, while others have developed statistics education programs across graduate schools. Additionally, a few organizations provide some statistics education at each graduate school. Because the goal is for participating organizations to develop educational programs for the systematic study of statistics, various efforts are being made. These include curricula reviews, the development of teaching materials, and provision of computers and software necessary for data analysis.

Graduate students who have completed a systematic course in statistics through this statistics education program are designated as Experts in Statistical Sciences regardless of their specialty. Additionally, graduate students who receive guidance directly from professors in statistics who trained through the Statistics Professors Training Program are also designated as Experts in Statistical Sciences.

International Cooperation

Associated Foreign Research Institutes

Organization name	Address	Conclusion date
The Statistical Research Division of the U.S. Bureau of the Census	USA (Washington)	July 27, 1988
Stichting Mathematisch Centrum	The Kingdom of the Netherlands (Amsterdam)	May 10, 1989
Institute for Statistics and Econometrics, Humboldt University of Berlin	Germany (Berlin)	December 8, 2004
The Steklov Mathematical Institute	Russia (Moscow)	August 9, 2005
Central South University	China (Changsha)	November 18, 2005
Soongsil University	The Republic of Korea (Seoul)	April 27, 2006
University of Warwick	The United Kingdom (Coventry)	January 16, 2007
Indian Statistical Institute	India (Kolkata)	October 11, 2007
Institute of Statistical Science, Academia Sinica	Taiwan (Taipei)	June 19, 2008
Department of Empirical Inference, Max Planck Institute for Biological Cybernetics	Germany (Tubingen)	August 11, 2010
Department of Communication Systems, SINTEF Information and Communication Technology	Norway (Trondheim)	January 30, 2012
University College London	The United Kingdom (London)	February 16, 2012
Department of Electronics and Telecommunications, Norwegian University of Science and Technology	Norway (Trondheim)	May 22, 2012
Department of Probability and Mathematical Statistics, Charles University in Prague	Czech Republic (Prague)	October 10, 2012
Department of Ecoinformatics, Biometrics and Forest Growth of the Georg-August University of Goettingen	Germany (Goettingen)	October 18, 2012
Korean Statistical Society (KSS)	The Republic of Korea (Seoul)	July 9, 2013
Toyota Technological Institute at Chicago	USA (Chicago)	February 10, 2014
Australian National University	Australia (Canberra)	May 15, 2014
RiskLab ETH Zurich	Switzerland (Zurich)	February 7, 2015
Institut de Recherche en Composants logiciel et matériel pour l'Information et la Communication Avancee	France (Paris)	February 9, 2015
Centre de Rechereche en Informatique, Signal et Automatique de Lille	France (Paris)	February 12, 2015
University College London Big Data Institute	The United Kingdom (London)	February 26, 2015
The Institute of Forestry, Pokhara of Tribhuvan University	Nepal (Pokhara)	March 6, 2015
The Institute of Forest and Wildlife Research and Development of the Forestry Administration of Cambodia	Cambodia (Phnom Penh)	March 6, 2015
Forest Inventory and Planning Institute of Vietnam	Vietnam (Hanoi)	June 2, 2015
Zuse Institute Berlin	Germany (Berlin)	June 20, 2016
The University of Porto	Portugal (Porto)	June 22, 2016
National University of Laos	Laos (Vientiane)	March 15, 2017
Institute of Geophysics China Earthquake Administration	China (Beijing)	April 28, 2017
Hong Kong Baptist University	Hong Kong (Kowloon Tong)	August 28, 2017
Unversidade de Évola	Portugal (Evola)	November 30, 2017
The Korean Association for Survey Research	The Republic of Korea (Seoul)	February 14, 2018
The Jean Golding Institute for data-intensive research, University of Bristol	The United Kingdom (Bristol)	January 15, 2019
Survey Research Center, Sungkyunkwan University	The Republic of Korea (Seoul)	February 25, 2019
University of Lampung	Indonesia (Lampung)	March 6, 2019
Department of Earth and Space Sciences, Southern University of Science and Technology	China (Shenzhen Shi)	March 25, 2019
Université Bretagne Sud	France (Lorient)	March 29, 2019
North Carolina State University	USA (Raleigh)	November 13, 2019
Singapore-ETH Centre	Singapore	March 18, 2020
Department of Actuarial Studies and Business Analytics, Macquarie University	Australia (Sydney)	December 21, 2020
EURECOM	France (Sophia Antipolis)	August 25, 2021

Associated Foreign Research Institutes

Organization name	Address	Conclusion date
The University of Texas at Dallas,School of Economic, Political and Policy Sciences	USA (Dallas)	March 11, 2022
Universität Ulm	Germany (Ulm)	February 20, 2023
Laboratoire de Mathématiques Blaise Pascal, University of Clermont Auvergne	France (Clermont-Ferrand)	March 13, 2023
Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS)	Italy (Sgonico)	March 30, 2023

Research Collaboration

ISM performs many activities for collaborating with researchers in the various fields of statistical science, from the individual level to the national level. The ISM cooperative research program regularly performs research activities to provide the research resources of ISM to researchers at universities or research institutes in order to advance their academic research. Available research resources include books, journals, supercomputers, some commercial statistical software packages, as well as statistical packages developed by ISM, and also the researchers in ISM themselves, who have abundant professional knowledge and experience in statistical science and data analysis. The ISM cooperative research program provides not only research support funds but also opportunities for the various researchers in many fields who require statistical knowledge to make use of the resources available at ISM. ISM's aim is to be a place for interaction and fusion among researchers inside and outside of ISM, and to contribute to multidisciplinary development of both the theory and the application of statistical science.

■ Number of Activities

Year	2017	2018	2019	2020	2021	2022
Number of Activities	161	166	178	145	143	122

■ Fields of Research Collaboration

Research collaboration is classified by research field as follows. Applicants can use the table below to find the most appropriate type of project.

ISM Fields

Number	Fields
a	Prediction and Control Group
b	Complex System Modeling Group
c	Data Assimilation Group
d	Survey Science Group
e	Metric Science Group
f	Structure Exploration Group
g	Mathematical Statistics Group
h	Learning and Inference Group
i	Mathematical Optimization Group
j	Others

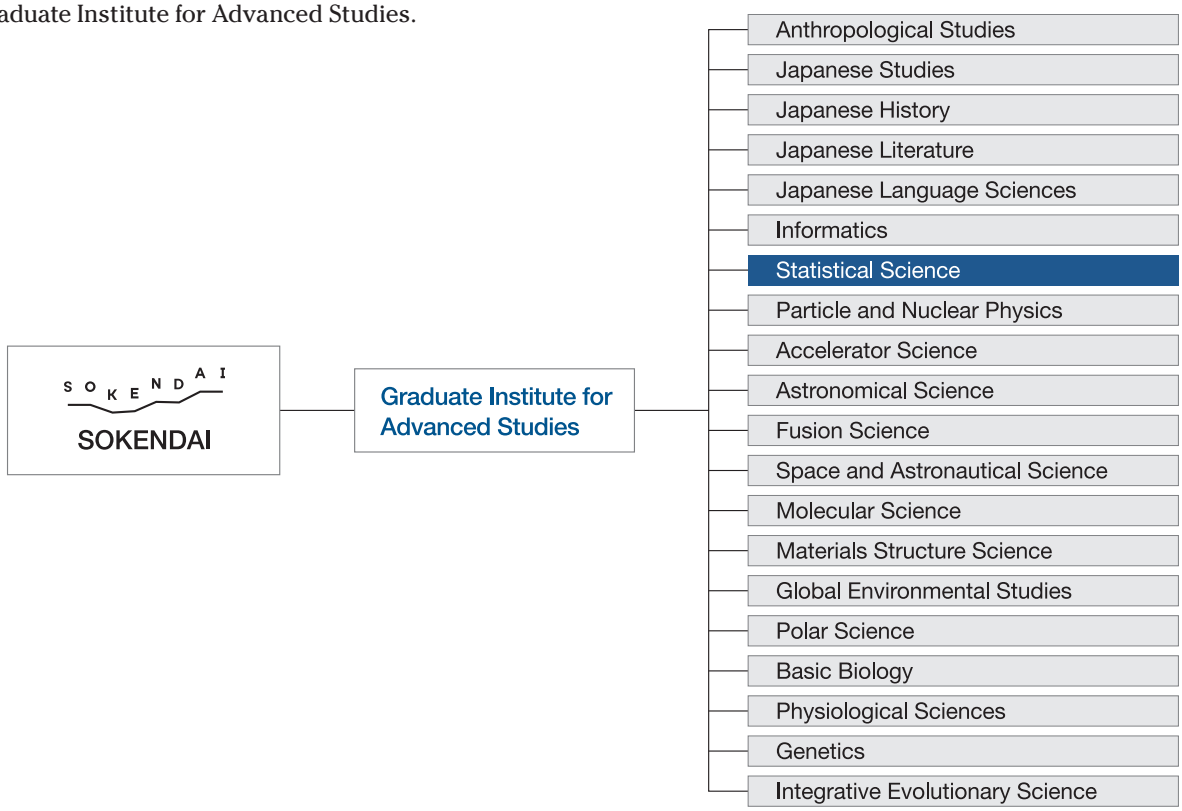
Major Research Fields

Number	Fields	Major Research Domains
1	Statistical mathematics	Mathematical theory of statistics, optimization, etc.
2	Information science	Algorithms, use of computer in statistics, etc.
3	Biological science	Medicine, pharmacy, epidemiology, genetics, etc.
4	Physical science	Space, planet, earth, polar region, materials, etc.
5	Engineering	Mechanics, electronics, control, chemistry, architecture, etc.
6	Human science	Philosophy, art, psychology, education, history, geography, culture, language, etc.
7	Social science	Economics, law, politics, society, management, official statistics, population, etc.
8	Environmental science	Environmental statistics, environmentrics, agricultural statistics, statistical meteorology, land economics, landscape management, forest management, etc.
9	Others	Other research fields

Graduate School Program

Organization

The Institute of Statistical Mathematics is one of the platforms of SOKENDAI (The Graduate University for Advanced Studies; the headquarters in Hayama, Kanagawa), which was opened in October 1988 to offer graduate education. Since its opening, the Institute has included the Department of Statistical Science and, since April 1989, has accepted students for education and research in doctoral programs. In 2006, the Institute adopted a five-year system, offering either a five-year education and research program, or a three-year education and research program starting from the third year of study. In April 2023, SOKENDAI has reorganized its educational structure and established the Statistical Science program under Graduate Institute for Advanced Studies.



Outline of Education and Research

The Statistical Science program, which is based on the Institute of Statistical Mathematics (ISM) serving as its underlying platform, aims to cultivate individuals who possess creative research skills to contribute to solving various important intricately-intertwined problems. To this end, the program conducts education and research related to the basis, mathematics and applications of data collection designs, modeling, inference and prediction, and equip students with the ability to extract information and knowledge from the real world based on the effective use of data.

Field of Education and Research	Contents
Statistical Modeling	We provide education and research focused on dynamic modeling such as spatial and space-time modeling, graphical modeling of temporally and/or spatially inter-related complex phenomena, and intelligent information processing. We also provide education and research on statistical inference based on various models, methods of calculation for inference, and evaluation of models based on data.
Statistical Data Science	We provide education and research on data design, investigation and analytical methods to cope with the uncertainty and incompleteness of information, as well as on computational statistics.
Statistical Inference and Mathematics	We provide education and research on the theory of statistics and related basic mathematics, statistical learning theory to extract information from data by automated learning and inference techniques; as well as theory and applications of optimization and computation algorithms which serve as the basis for computational inference.

Features of Education and Research

- Statistical Science program is one of the few comprehensive doctoral programs in statistical science in Japan, and has accepted students from a wide range of academic fields. Education and research in all aspects of statistical science is conducted by faculty members specializing in a variety of fields, from theory to application.
- The Institute of Statistical Mathematics, the platform for the program, is equipped with a world-class super computer, as well as a variety of software, including original statistical software developed by the Institute.
- The Institute of Statistical Mathematics has an extensive library covering a wide variety of journals and books on statistical and mathematical sciences.
- The Institute of Statistical Mathematics, as a joint research institute, frequently holds research meetings and seminars presented by visiting professors and researchers from Japan and abroad. Students are encouraged to participate in these seminars and interact with the presenters.
- Students have the opportunity to participate in different research projects through collaborations with other universities and research institutes.

Requirements for Graduation in/after AY 2023

3-year doctoral program

To be enrolled at the Graduate Institute for Advanced Studies for more than three years (excluding the period of leave of absence).
To earn at least 16 credits, including 12 credits of Dissertation Work in Advanced Studies ⅢA~VB.

5-year doctoral program

To be enrolled at the Graduate Institute for Advanced Studies for more than five years (excluding the period of leave of absence).
To earn at least 42 credits, including 20 credits of Dissertation Work in Advanced Studies IA~VB.

To receive the necessary research guidance and pass an examination for a doctoral thesis.
To make full payment for the tuition fee (excluding students with the exemption of the tuition fee).

Number of Students (As of April 1, 2023)

5-year doctoral course:Quota,2

Year of enrollment	2019	2021	2022	2023
Number of students	1	1	1	1

3-year doctoral course:Quota,3

2016	2018	2019	2020	2021	2022	2023
1 ①	3 ③	6 ⑤	3 ③	5 ③	9 ⑦	6 ④

* The figures in circles indicate those who are employed by other organizations.

University Background of Students

National and public universities

• Hokkaido University (5) • Tohoku University (5) • Fukushima University (1) • University of Tsukuba (8) • Saitama University (1) • Chiba University (1) • Ochanomizu University (1) • National Graduate Institute for Policy Studies (1) • Tokyo Medical and Dental University (1) • Tokyo University of Marine Science and Technology (1) • Tokyo Gakugei University (2) • Tokyo Institute of Technology (6) • The University of Tokyo (30) • Tokyo Metropolitan University (1) • Tokyo University of Agriculture and Technology (1) • Hitotsubashi University (7) • Shizuoka University (1) • Kanazawa University (1) • Japan Advanced Institute of Science and Technology (1) • Nagoya University (4) • Toyohashi University of Technology (2) • Kyoto University (9) • Osaka City University (1) • Osaka University (3) • Nara Institute of Science and Technology (1) • Okayama University (2) • Shimane University (3) • Kyushu University (5) • Oita University (1) • The University of Electro-Communications (2) • University College London (1) • University of London (1)

University Background of Students

Private universities

• Aoyama Gakuin University (1) • Kitasato University (1) • Keio University (8) • International Christian University (1) • Shibaura Institute of Technology (1) • Sophia University (1) • Chuo University (9) • Tokyo University of Science (7) • Toyo University (1) • Japan Women's University (1) • Nihon University (2) • Hosei University (7) • Waseda University (9) • Nanzan University (1) • Osaka Electro-Communication University (1) • Kansai University (1) • Kyoto Sangyo University (1) • Ritsumeikan University (1) • Okayama University of Science (1) • Kurume University (1)

Foreign universities

• Aston University (1) • University of California, Irvine (1) • California State University, Long Beach (1) • University of Campinas (1) • University of Colorado Boulder (2) • University of Dhaka (2) • University of Hawaii (1) • Jahangirnagar University (2) • University of Malaya (1) • Northeast Normal University (1) • Ohio University (2) • University of Rajshahi (2) • Stanford University (1) • The University of Nottingham (1) • Zhejiang University (1) • Institute of Applied Mathematics, AMSS, CAS (1) • University of Science and Technology of China (1) • Center for Analysis and Prediction, China Seismological Bureau (1) • Northeastern University (1) • The Hong Kong University of Science and Technology (1) • China University of Geosciences (1)

Degrees Awarded

Year	2016	2017	2018	2019	2020	2021	2022
Doctor of Philosophy	7	5	5	5	4	7	10

Alumni

National and public universities, and public organizations

• Obihiro University of Agriculture and Veterinary Medicine • University of Tsukuba • University of Hyogo • The University of Tokyo • The University of Electro-Communications • Saitama University • Nagoya University • Kyushu University • Kyushu Institute of Technology • University of the Ryukyus • The Institute of Statistical Mathematics • Tohoku University • Yokohama National University • Hokkaido University • Tokyo Institute of Technology • Hiroshima University • Oita University of Nursing and Health Sciences • JAXA's Engineering Digital Innovation Center • Kyoto University • Nara Institute of Science and Technology • Bank of Japan • Japan Broadcasting Corporation • Railway Technical Research Institute • Statistical Information Institute for Consulting and Analysis • Government Pension Investment Fund • Public School • RIKEN • Statistics Bureau of Japan • Pharmaceuticals and Medical Devices Agency (PMDA) • National Institute of Information and Communications Technology

Private universities

• Sapporo Gakuin University • Tokyo Health Care University • Meiji University • Doshisha University • Josai University • Nihon University • Komazawa University • Aichi University of Technology • Tokyo University of Information Sciences • Shibaura Institute of Technology • Rikkyo University • Waseda University • Keio University • Tokyo Medical University

Foreign universities

• Jahangirnagar University • Victoria University • Massey University • University of Otaga • Statistics New Zealand • University of Rajshahi • University of California, Los Angeles • Asia-Pacific Center for Security Studies Department • Central South University • Hong Kong Baptist University • University of South Carolina • The University of Warwick

Private companies, etc.

• Hitachi, Ltd. Central Research Laboratory • NTT Communication Science Laboratories • Seiwa Kikaku • NLI Research Institute • Mizuho Trust and Banking • Nomura Securities Co., Ltd. • ATR Computational Neuroscience Laboratories • Toyota Motor Corporation, Higashi-Fuji Technical Center • Schlumberger Limited • Macquarie Securities, Japan • Non-Life Insurance Rating Organization of Japan • Barclays Global Investors • Open Technologies Corporation • Yamaha Corporation • Goldman Sachs Asset Management L.P. • CLC bio Japan, Inc. • MUFG Bank, Ltd. • Pfizer Japan Inc. • Doctoral Institute for Evidence Based Policy • Sony Corporation • NTTIT Corporation • Sompo Japan Insurance Inc. • Qualicaps Co.,Ltd. • Bridgestone Corporation • Brain Pad Inc. • Sumitomo Chemical Co.,Ltd. • PricewaterhouseCoopers Aarata • Mitsubishi Tanabe Pharma Corporation • Daiichi Sankyo Co.,Ltd. • Shizuoka Cancer Center • CPC Clinical Trial Hospital, Medipolis Medical Research Institute • CRD Association • Japan Society for the Promotion of Science • Tokyo Electric Power Company Holdings, Inc. • Asahi Kasei Corporation • Honda R&D Co.,Ltd. • Yokogawa Electric Corporation • Kao Corporation • Advanced Smart Mobility Co., Ltd. • NEC Corporation • Janssen Pharmaceutical K.K. • Taisho Pharmaceutical Holdings • Otsuka Pharmaceutical Co., Ltd. • Kyowa Kirin Co., Ltd. • KOSÉ Corporation • Novartispharma K.K. • Nikkei Inc. • Mizuho–DL Financial Technology Co., Ltd. • Daicel Corporation • Aichi Steel Corporation

Facilities and Equipment

Computational Resources (As of April 1, 2023)

ISM is operating a supercomputer system, the Supercomputer System for Statistical Science, which is suitable for analyzing large-scale datasets. The Supercomputer System for Statistical Science, an HPE SGI 8600 system, has been operated since October 2018. The system is a distributed-memory parallel computer that has total theoretical peak performance of 1.49 PFLOPS. The system is liquid cooled and consists of 384 computing nodes. Each node has two CPU chips (Intel Xeon GOLD 6154) with 18 cores and has 384 GB memory. The system includes hardware random number generator.

In March 2021, we introduced the Communal Cloud Computing System to provide a computing environment that is easy for each user to use and customize. This system is equipped with 64 computing nodes (HPE ProLiant DL385 Gen 10 Plus; total theoretical computing performance of 154.0 TFLOPS), and each node has two 32-core CPUs (AMD EPYC 7452), 1 TB of main memory, and an SSD with 20 TB of usable capacity.

In March 2023, we launched the Supercomputer System for Data Assimilation to advance the analysis of large-scale data without parallel programming. This is a distributed shared-memory computer with a large memory, which can be accessed from any CPU. This system is equipped with two HPE Superdome Flex computing nodes and has a total theoretical computing performance of 154.8 TFLOPS. Each node is equipped with 32 28-core CPUs (Intel Xeon Platinum 8280L) with a main memory of 48 TB, and an SSD with 880 TB of usable capacity.

In the main office building, the primary local area network (LAN) consists of an Ethernet network using 10GBase-SR for the main trunk and 1000Base-T for branches. The personal computers in researchers' offices and the supercomputer system are all connected to this network. A wireless LAN system is also available in the immediate area of the building occupied by ISM. These LAN systems enable distributed processing and allow computing resources and statistical data to be used effectively. Comprehensive network security methods have been implemented, such as a firewall system, anti-virus software, and an intrusion prevention system. To encourage joint research with researchers both in Japan and abroad, as well as the exchange of e-mails, the network is connected to the Internet through SINET6 (100Gbps).

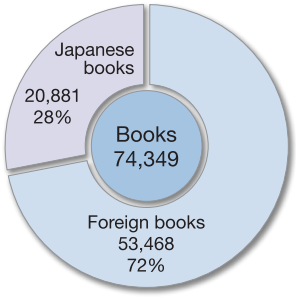
Supercomputer System for Data Assimilation (HPE Superdome Flex)

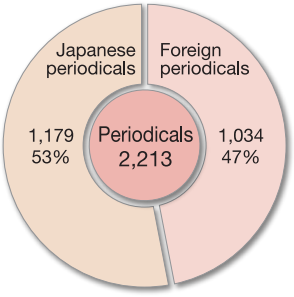
Library and Materials (As of April 1, 2023)

We have a large number of major Japanese/foreign journals covering a wide variety of fields including statistics, mathematics, computer science and informatics. In addition, we also have a large library consisting of books on humanities, social science, biology, medical science, science and engineering.

Besides contributed to Japanese and foreign publications, we also have a collection of journals that we publish ourselves: Annals of the Institute of Statistical Mathematics (English; Springer), Proceedings of the Institute of Statistical Mathematics (Japanese), ISM Survey Research Report (Statistical Researches mainly related to the Japanese National Character), Computer Science Monographs, Cooperative Research Reports (for collaborative research projects), Research Memorandum, ISM Reports on Statistical Computing, and ISM Report on Research and Education.

All materials are properly catalogued and can be searched from the web in order to meet the needs of researchers working in a wide of fields. We also accept photocopy requests.





Finance and Buildings

Administration Subsidy and Others (2022)

Type	Personnel expenses	Non-personnel expenses	Total
Expenditure	628,500	838,663	1,467,163

Unit: 1,000JPY

Accepted External Funds (2022)

Type	Items	Income
Joint research	20	32,728
Joint research division	2	21,700
Subcontracted research, Trustee business	23	515,557
Contract researchers	—	—
Academic consulting	7	6,424
Contribution for scholarship	2	4,100
Total	54	580,509

Unit: 1,000JPY

Grants-in-Aid for Scientific Research "KAKENHI" (2022)

Research Category	Items	Amount Granted
Grant-in-Aid for Scientific Research on Innovative Areas	2	19,370
Grant-in-Aid for Transformative Research Areas (A)	1	10,920
Grant-in-Aid for Transformative Research Areas (B)	1	10,140
Grant-in-Aid for Scientific Research (S)	—	—
Grant-in-Aid for Scientific Research (A)	2	15,860
Grant-in-Aid for Scientific Research (B)	9	31,980
Grant-in-Aid for Scientific Research (C)	14	15,481
Grant-in-Aid for Challenging Research (Exploratory)	1	1,300
Grant-in-Aid for Challenging Research (Pioneering)	1	5,590
Grant-in-Aid for Early-Career Scientists	14	13,242
Grant-in-Aid for Forming an Independent Foundation	—	—
Grant-in-Aid for Research Activity Start-up	3	3,120
Grant-in-Aid for JSPS Fellows	—	—
Total	48	127,003

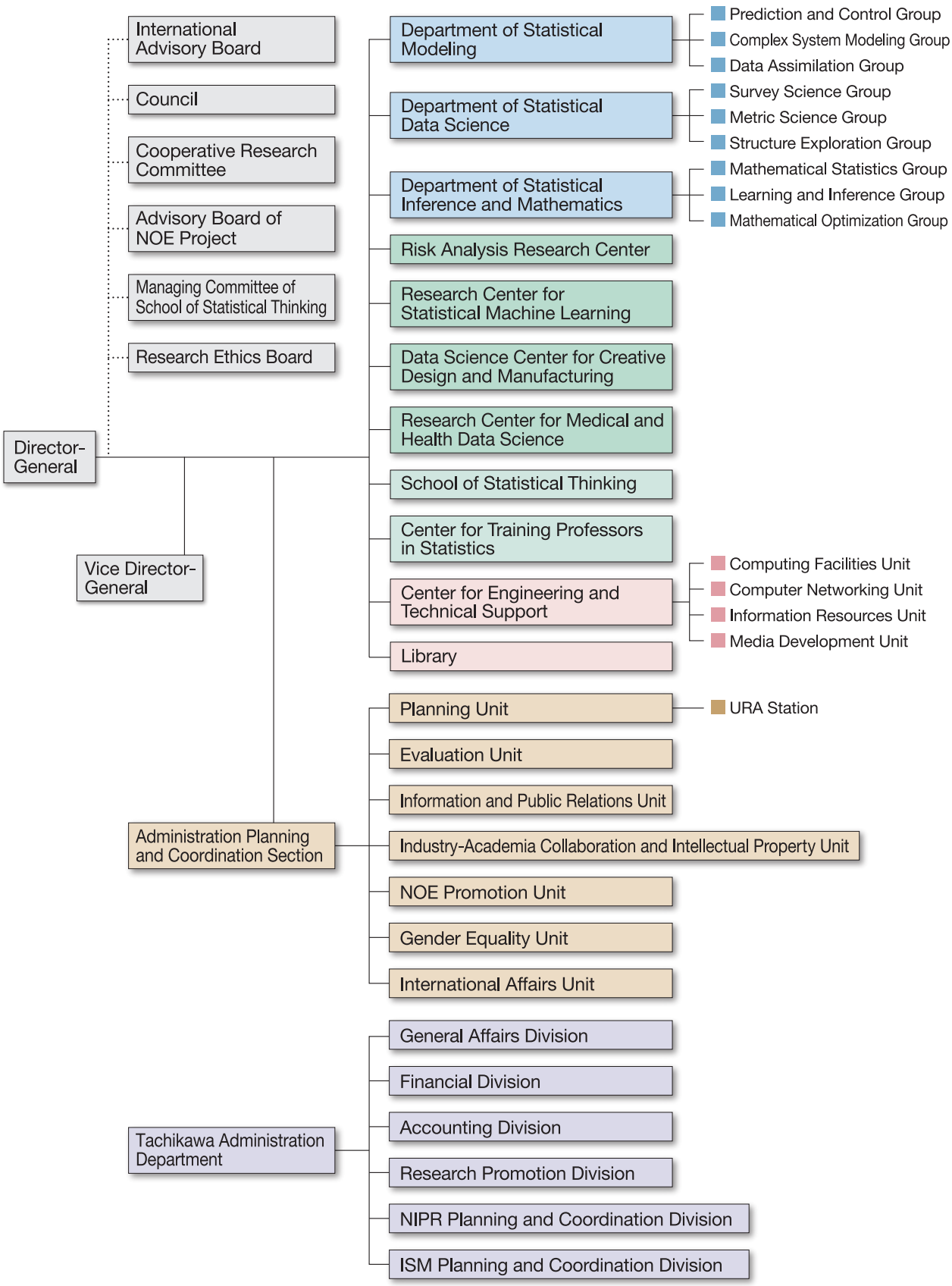
Unit: 1,000JPY

Site and Buildings (As of April 1, 2023)

Site Area	62,450m^2
Area for Buildings (total)	16,209m^2

Organization

Organization Diagram (As of April 1, 2023)



Number of Staff (As of April 1, 2023)

Type	Director-General	Professor	Associate Professor	Assistant Professor	Administ-rative Staff	Technical Staff	Total
Director-General	1						1
Department of Statistical Modeling		7	3				10
Department of Statistical Data Science		7	6	2			15
Department of Statistical Inference and Mathematics		7	10	1			18
School of Statistical Thinking				5			5
Center for Engineering and Technical Support						10	10
Administration Planning and Coordination Section					1		1
Tachikawa Administration Department					(39)		(39)
Total	1	21	19	8	1(39)	10	60(39)

( ) Total number of staff of Tachikawa Administration Department.

The number under Technical Staff at the Center for Engineering and Technical Support and Administrative staff at the Tachikawa Administration Department include one each staff member who retired because of age but was reemployed in a different position.

Staff (As of August 1, 2023)

Director-General	Hiroe TSUBAKI				
Vice Director-General	Yoshinori KAWASAKI	Vice Director-General	Satoshi YAMASHITA	Vice Director-General	Kazuhiro MINAMI

Department of Statistical Modeling

Director Tomoko MATSUI

Prediction and Control Group

Prof.	Yoshinori KAWASAKI	Prof.	Jiancang ZHUANG	Assoc. Prof.	Yumi TAKIZAWA
Assoc. Prof.	Fumikazu MIWAKEICHI	Project Researcher	Hiroka HAMADA		

Complex System Modeling Group

Prof.	Tomoko MATSUI	Prof.	Yukito IBA	Prof.	Hideitsu HINO
Prof	Kengo KAMATANI	Assoc. Prof.	Shinsuke KOYAMA		

Data Assimilation Group

Prof.	Shinya NAKANO	Prof.	Genta UENO	Project. Prof.	Shigeru FUJITA
Project Researcher	Zhiheng LIN	Visiting Prof.	Tadahiko SATO	Visiting Prof.	Kazuyuki NAKAMURA
Visiting Prof.	Tomoyuki HIGUCHI	Visiting Prof.	Masako KAMIYAMA	Visiting Prof.	Toshikazu KITANO
Visiting Assoc. Prof.	Yosuke FUJII	Visiting Assoc. Prof.	Shunichi NOMURA	Visiting Assoc. Prof.	Hiroshi KATO
Visiting Assoc. Prof.	Hiromichi NAGAO	Visiting Assoc. Prof.	Masaya SAITO	Visiting Assoc. Prof.	Takashi YAMAMOTO

Department of Statistical Data Science

Director Atsushi YOSHIMOTO

Survey Science Group

Prof.	Kazuhiro MINAMI	Prof.	Atsushi YOSHIMOTO	Assoc. Prof.	Tadahiko MAEDA
Assoc. Prof.	Yoo Sung PARK	Assoc. Prof.	Takao MURAKAMI	Project Assist. Prof.	Kiyohisa SHIBAI
Project Assist. Prof.	Mika ICHINO	Project Researcher	Yasuhiro TANAKA	Project Researcher	Xiaoxing WANG
Visiting Prof.	Toru KIKKAWA	Visiting Prof.	Takatoshi IMADA	Visiting Prof.	Yoshimichi SATO
Visiting Prof.	Wataru MATSUMOTO	Visiting Prof.	Kazufumi MANABE	Visiting Assoc. Prof.	Naoko KATO
Visiting Assoc. Prof.	Yusuke INAGAKI	Visiting Assoc. Prof.	Taisuke FUJITA	Visiting Assoc. Prof.	Koken OZAKI

Staff

Department of Statistical Data Science

Metric Science Group

Prof.	Satoshi YAMASHITA	Prof.	Koji KANEFUJI	Prof.	Shigeyuki MATSUI
Prof.	Hisashi NOMA	Prof.	Takeshi EMURA	Assoc. Prof.	Ikuko FUNATOGAWA
Assist. Prof.	Nobuo SHIMIZU				

Structure Exploration Group

Prof.	Ryo YOSHIDA	Assoc. Prof.	Jun ADACHI	Assoc. Prof.	Kenichiro SHIMATANI
Assoc. Prof.	Stephen WU	Assoc. Prof.	Daisuke MURAKAMI	Assist. Prof.	Yoshihiro HAYASHI
Visiting Prof.	Tomoya MORI	Visiting Assoc. Prof.	Yu OTAKE		

Department of Statistical Inference and Mathematics

Director Satoshi ITO

Mathematical Statistics Group

Prof.	Satoshi KURIKI	Prof.	Yoshiyuki NINOMIYA	Prof.	Shuhei MANO
Assoc. Prof.	Shogo KATO	Assoc. Prof.	Takaaki SHIMURA	Assoc. Prof.	Keisuke YANO
Visiting Prof.	Yoshihiko KONNO				

Learning and Inference Group

Prof.	Kenji FUKUMIZU	Prof.	Hironori FUJISAWA	Assoc. Prof.	Daichi MOCHIHASHI
Assoc. Prof.	Masayuki HENMI	Assoc. Prof.	Ayaka SAKATA	Assist. Prof.	LE Thanh Tam

Mathematical Optimization Group

Prof.	Satoshi ITO	Prof.	Shiro IKEDA	Assoc. Prof.	Mirai TANAKA
Assoc. Prof.	Bruno FIGUEIRA LOURENÇO	Assoc. Prof.	Tasuku SOMA	Assoc. Prof.	LEE Ching-pei

Risk Analysis Research Center

Director Shogo KATO Vice Director Satoshi YAMASHITA

Prof.	Satoshi YAMASHITA	Prof.	Satoshi KURIKI	Prof.	Koji KANEFUJI
Prof.	Tomoko MATSUI	Prof.	Atsushi YOSHIMOTO	Prof.	Yoshinori KAWASAKI
Prof.	Yoshiyuki NINOMIYA	Prof.	Kazuhiro MINAMI	Prof.	Shuhei MANO
Prof.	Kengo KAMATANI	Prof.	Jiancang ZHUANG	Project Prof.	Kunio SHIMIZU
Assoc. Prof.	Keisuke YANO	Assoc. Prof.	Masayuki HENMI	Assoc. Prof.	Kenichiro SHIMATANI
Assoc. Prof.	Shogo KATO	Assoc. Prof.	Yumi TAKIZAWA	Assoc. Prof.	Takaaki SHIMURA
Assoc. Prof.	Stephen WU	Assoc. Prof.	Ikuko FUNATOGAWA	Assoc. Prof.	Daisuke MURAKAMI
Project Assoc. Prof.	Masayuki KUMON	Project Assoc. Prof.	Takao KUMAZAWA	Project Assist. Prof.	TRAN Duc Vu
Project Assist. Prof.	XUE Yujie	Project Assist. Prof.	Petrillo GIUSEPPE	Project Researcher	Yosihiko OGATA
Project Researcher	PENG Hong	Visiting Prof.	Yo SHEENA	Visiting Prof.	Masao UEKI
Visiting Prof.	Takashi KAMEYA	Visiting Prof.	Shunji HASHIMOTO	Visiting Prof.	Naoki SAKAI
Visiting Prof.	Satoshi TAKIZAWA	Visiting Prof.	Mihoko MINAMI	Visiting Prof.	Toshihiro HORIGUCHI
Visiting Prof.	Tetsuji TONDA	Visiting Prof.	Rinya TAKAHASHI	Visiting Prof.	Yoshiki YAMAGATA
Visiting Prof.	Katsutoshi NAGASHIMA	Visiting Prof.	Tetsuya IWASA	Visiting Prof.	Hiroaki NAGAFUJI
Visiting Prof.	Natsuki SANO	Visiting Prof.	Takayuki SASAJIMA	Visiting Prof.	Hisayuki HARA
Visiting Prof.	Shinsuke ITO	Visiting Prof.	Takafumi KUBOTA	Visiting Prof.	Kiyomi SHIRAKAWA
Visiting Prof.	Sadaaki MIYAMOTO	Visiting Prof.	Yasushi YOSHIDA	Visiting Prof.	Masakazu ANDO
Visiting Prof.	Yukihiko OKADA	Visiting Prof.	Nakahiro YOSHIDA	Visiting Prof.	Takaaki YOSHINO
Visiting Prof.	Isao TAKABE	Visiting Prof.	Tadashi ONO	Visiting Prof.	Hiroshi TSUDA
Visiting Prof.	Satoshi FUJII	Visiting Prof.	Kazuyuki SUZUKI	Visiting Prof.	Masaaki FUKASAWA
Visiting Prof.	Yasutaka SHIMIZU	Visiting Prof.	Hideatsu TSUKAHARA	Visiting Prof.	Toshio HONDA
Visiting Prof.	Makoto ITOH	Visiting Prof.	Toshinao YOSHIBA	Visiting Prof.	Aitaro KATO
Visiting Prof.	Hitoshi MOTOYAMA	Visiting Prof.	Hiroshi MATSUZOE	Visiting Prof.	Kenichi KAMO
Visiting Prof.	Masashi KONOSHIMA	Visiting Prof.	Hirokazu YANAGIHARA	Visiting Prof.	Takenori TAKAHASHI
Visiting Assoc. Prof.	Dou XIAOLING	Visiting Assoc. Prof.	Teppei OGIHARA	Visiting Assoc. Prof.	Tomoaki IMOTO

Risk Analysis Research Center

Visiting Assoc. Prof.	Koyomi NAKAZAWA	Visiting Assoc. Prof.	Keisuke FUKUI	Visiting Assoc. Prof.	Noriyoshi SAKUMA
Visiting Assoc. Prof.	Tatsuhiko SAIGOH	Visiting Assoc. Prof.	Junichi TAKAHASHI	Visiting Assoc. Prof.	Seisho SATO
Visiting Assoc. Prof.	Yuta KOIKE	Visiting Assoc. Prof.	Hideaki NAGAHATA	Visiting Assoc. Prof.	Yuta TANOUE
Visiting Assoc. Prof.	Hayafumi WATANABE	Visiting Assoc. Prof.	Yuuki RIKIMARU	Visiting Assoc. Prof.	Bogdan Dumitru ENESCU
Visiting Assoc. Prof.	Kazuyoshi NANJO	Visiting Assoc. Prof.	Masumi YAMADA	Visiting Assoc. Prof.	Shunichi NOMURA
Visiting Assoc. Prof.	Takaki IWATA	Visiting Assoc. Prof.	Yuma UEHARA	Visiting Assoc. Prof.	Yuta MITSUI

Research Center for Statistical Machine Learning

Director Kenji FUKUMIZU　　Vice Director Tomoko MATSUI

Prof.	Kenji FUKUMIZU	Prof.	Tomoko MATSUI	Prof.	Yukito IBA
Prof.	Satoshi ITO	Prof.	Shiro IKEDA	Prof.	Satoshi KURIKI
Prof.	Shuhei MANO	Prof.	Hironori FUJISAWA	Prof.	Kazuhiro MINAMI
Prof.	Hideitsu HINO	Assoc. Prof.	Daichi MOCHIHASHI	Assoc. Prof.	Shinsuke KOYAMA
Assoc. Prof.	Ayaka SAKATA	Assoc. Prof.	Mirai TANAKA	Assoc. Prof.	Daisuke MURAKAMI
Assoc. Prof.	LEE Ching-pei	Assist. Prof.	Kohei HATTORI	Assist. Prof.	Masato SHIRASAKI
Assist. Prof.	Akifumi OKUNO	Assist. Prof.	LE Thanh Tam	Project Assist. Prof.	Kotaro SAKAMOTO
Project Assist. Prof.	Hideto NAKASHIMA	Project Researcher	ZHENG Ning	Project Researcher	Syoji TOYOTA
Visiting Prof.	Arthur GRETTON	Visiting Prof.	Shuichi KAWANO	Visiting Prof.	Konstantin MARKOV
Visiting Prof.	Masataka GOTO	Visiting Prof.	Katsuki FUJISAWA	Visiting Prof.	Yuji SHINANO
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Visiting Assoc. Prof.	Tsutomu TAKEUCHI	Visiting Assoc. Prof.	Sayaka SHIOTA	Visiting Assoc. Prof.	Eiji MOTOHASHI

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Project Researcher	Syunya MINAMI	Project Researcher	Hironao YAMADA	Project Researcher	Yoh NOGUCHI
Project Researcher	Kaoru KIMURA	Visiting Prof.	Junichiro SHIOMI	Visiting Prof.	Junko MORIKAWA
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Visiting Prof.	Ken KIYONO	Visiting Prof.	Nobuaki NISHIYAMA	Visiting Prof.	Hisateru TACHIMORI
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Director Masato CHINO

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Chief Director Hiroe TSUBAKI

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Vice Director of Evaluation Unit	Yoshihiko MIYASATO	Director of Information and Public Relations Unit	Kazuhiro MINAMI
Vice Director of Information and Public Relations Unit	Yoshihiko MIYASATO	Director of Intellectual Property Unit	Satoshi YAMASHITA
Director of NOE Promotion Unit	Satoshi YAMASHITA	Director of Gender Equality Unit	Yoshinori KAWASAKI
		Director of International Affairs Unit	Kazuhiro MINAMI

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Kozo KITAMURA	Motoi OKAMOTO	Keisuke HONDA

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Head, Personnel and Labor Management Team (ISM)	Yusuke KASAKAWA		

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Head, Budget and Account Settlement Team (ISM)	Akiko MAEKAWA	Head, Assets Management and Acceptance Team	Taku SASAKI

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Tachikawa Administration Department

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Head, Contract Team (ISM)	Hiroshi TAKAGI	Head, Facilities Team	Takuya SAITO

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Manager Masakazu ICHIKAWA　Deputy Manager Hiromi OBAMA

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NIPR Planning and Coordination Division

Manager Koji SAKAMOTO

Head, NIPR Planning and Coordination Team	Yuki SETOGUCHI

ISM Planning and Coordination Division

Manager Masaya MASADA　Deputy Manager Wataru HASHIMOTO

Head, ISM Planning and Coordination Team	Wataru HASHIMOTO

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Yasuhiro OMORI	Professor, Faculty of Economics, University of Tokyo
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Kazuhiro MINAMI	Professor (Vice Director-General, ISM)
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Atsushi YOSHIMOTO	Professor (Director of Department of Statistical Data Science, ISM)
Satoshi ITO	Professor (Director of Department of Mathematical Analysis and Statistical Inference, ISM)
Genta UENO	Professor (Director of Center for Engineering and Technical Support, ISM)
Satoshi KURIKI	Professor (Director of School of Statistical Thinking, ISM)
Kenji FUKUMIZU	Professor (Department of Mathematical Analysis and Statistical Inference, ISM)
Hironori FUJISAWA	Professor (Department of Mathematical Analysis and Statistical Inference, ISM)

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Toshinao YOSHIBA	Professor, Graduate School of Management, Tokyo Metropolitan University
Kenichiro SHIMATANI	Associate Professor (Department of Statistical Data Science, ISM)
Hiroko NAKANISHI	Project Professor (Center for Training Professors in Statistics, ISM)
Takafumi KUBOTA	Professor, School of Management & Information Sciences, Tama University
Aki-Hiro SATO	Professor, Department of Data Science, Graduate School of Data Science, Yokohama City University
Kengo KAMATANI	Professor (Department of Statistical Modeling, ISM)
Mirai TANAKA	Associate Professor (Department of Statistical Inference and Mathematics, ISM)

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Jinfang WANG	Professor, School of International Liberal Studies, Waseda University
Yukito IBA	Vice Director (School of Statistical Thinking, ISM)
Hiroko NAKANISHI	Project Professor (Center for Training Professors in Statistics, ISM)
Manabu KOBAYASHI	Professor, Center for Data Science, Waseda University
Yoshihiko NISHINO	Director, Advanced Analytics & AI Innovation Division, SAS Institute Japan, Ltd.
Satoshi KURIKI	Director (School of Statistical Thinking, ISM)
Yoshinori KAWASAKI	Professor (Vice Director-General, ISM)

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Specialist on epidemiology and social research	Keiko SATO	Associate Professor, Department of Health Informatics Graduate School of Medicine & School of Public Health, Kyoto University
Specialist in the field of ethics and law	Hitomi NAKAYAMA	Lawyer, Kasumigaseki-Sogo Law Offices
Specialist in the field of ethics and law	Hiroe TSUBAKI	Director-General, The Institute of Statistical Mathematics
Person in citizen's position	Yutaka KURIKI	Director, Social welfare corporation Kunitachi nursery school
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Research education staff of ISM	Tadahiko MAEDA	Associate Professor (Department of Data Science, ISM)
Research education staff of ISM	Yoo Sung PARK	Associate Professor (Department of Data Science, ISM)

Professor Emeritus (As of April 1, 2023)

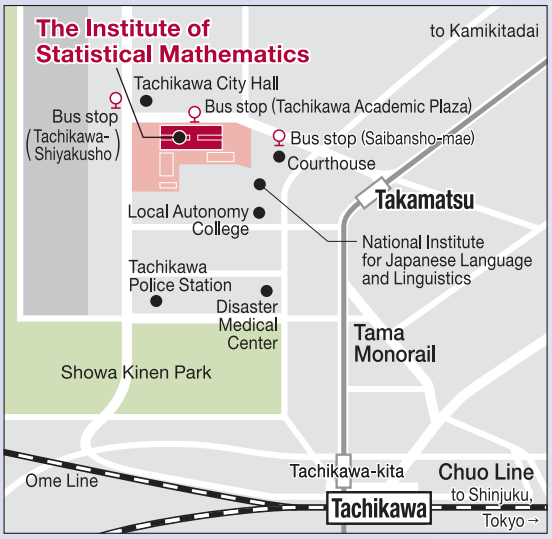
Sigeki NISIHIRA	Tatsuzo SUZUKI	Giitiro SUZUKI	Ryoichi SHIMIZU
Noboru OHSUMI	Masakatsu MURAKAMI	Kunio TANABE	Tadashi MATSUNAWA
Masami HASEGAWA	Yoshiyuki SAKAMOTO	Takemi YANAGIMOTO	Yoshiaki ITOH
Yasumasa BABA	Katsuomi HIRANO	Masaharu TANEMURA	Makio ISHIGURO
Yosihiko OGATA	Hiroe TSUBAKI	Genshiro KITAGAWA	Nobuhisa KASHIWAGI
Takashi NAKAMURA	Yoshiyasu TAMURA	Tomoyuki HIGUCHI	Junji NAKANO
Shinto EGUCHI	Ryozo YOSHINO	Yoshihiko MIYASATO	

History

1944	June	Based on a proposal submitted at an academic study conference in December 1943, the organization was founded as an institute under the direct control of the Ministry of Education. This proposal aimed to provide supervision for studies looking into the mathematical principles of probability and their application, and was also intended to facilitate, unify and promote the publication of research results.
1947	April	The affiliated statistical specialists' school was opened.
	May	The Institute was divided into the 1st Research Dept. (fundamental theories), the 2nd Research Dept. (statistical theories for the natural sciences), and the 3rd Research Dept. (statistical theories for the social sciences).
1949	June	The Institute was placed under the control of the Ministry of Education because of the enforcement of the Ministry of Education Establishment Law.
1955	September	Reorganized into the 1st Research Dept. (fundamental theories), the 2nd Research Dept. (natural and social science theories), and the 3rd Research Dept. (operations research, statistical analysis theories). The laboratory system, comprising 9 laboratories and the research guidance promotion room, was adopted.
1969	October	A new office building was constructed in Minato Ward.
1971	April	The 4th Research Dept. (informatics theories) was instituted.
1973	April	The 5th Research Dept. (prediction and control theories) was instituted.
1975	October	The 6th Research Dept. (statistical theories of human behavior) was instituted.
1979	November	The Information Research Building was constructed.
1985	April	Repositioned as a National Inter-University Research Institute due to the regulation change. The new mission includes providing facilities and skills to other universities, in addition to conducting cutting-edge research on statistical mathematics. Accordingly, the institute was reorganized into four basic research departments (Fundamental Statistical Theory, Statistical Methodology, Prediction & Control, and Interdisciplinary Statistics) and two strategic centers (Statistical Data Analysis Center and Statistical Education & Information Center). The Statistical Technical Training Center was terminated.
1988	October	The Dept. of Statistical Science was instituted in the School of Mathematical and Physical Science, part of the Graduate University for Advanced Studies (SOKENDAI).
1989	June	The Institute was reorganized as an Inter-University Research Institute based on the National School Establishment Law.
1993	April	The Planning Coordination Chief System was instituted.
1997	April	The affiliated Statistical Data Analysis Center was reorganized into the Center for Development of Statistical Computing, and the Statistical Education and Information Center was reorganized into the Center for Information on Statistical Sciences.
2003	September	The Prediction and Knowledge Discovery Research Center was instituted.
2004	April	The Institute was reorganized into the Institute of Statistical Mathematics, part of the Research Organization of Information and Systems of the Inter-University Research Institute based on the National University Corporation Law. The Planning Coordination Chief System was abolished and the position of Vice Director-General was instituted instead. The Dept. of Statistical Science in the School of Mathematical and Physical Science, SOKENDAI, was reorganized. In addition, the Dept. of Statistical Science and the School of Multidisciplinary Sciences were instituted.
2005	April	The research organization was reorganized into three research departments (the Department of Statistical Modeling, the Department of Data Science, and the Department of Mathematical Analysis and Statistical Inference). The affiliated Center for Development of Statistical Computing, the Center for Information on Statistical Sciences, and the Engineering and Technical Services Section were integrated into the Center for Engineering and Technical Support. The Risk Analysis Research Center was instituted.
2006	April	The Administration Planning Coordination Unit was instituted.
2008	April	The Research Innovation Center was instituted. The Administration Planning and Coordination Unit was reorganized into the Administration Planning and Coordination Section (hereafter APCS), within which the Intellectual Property Unit, the Evaluation Unit and the Information and Public Relations Unit were instituted.
2009	January	The Planning Unit was instituted within APCS.
	October	The Institute was moved to 10-3 Midori-cho, Tachikawa, Tokyo.

2010	June	Officially opened the Akaike Guest House.
	July	Reorganized the Administration Office to create the NIPR/ISM Joint Administration Office and launch the General Service Center. The NOE Forwarding Unit (now we call “NOE Promotion Unit”) was instituted within APCS.
2011	January	Research and Development Center for Data Assimilation was instituted. Survey Science Center was instituted.
2012	January	Research Center for Statistical Machine Learning, Service Science Research Center and School of Statistical Thinking were instituted.
2014	July	The URA Station was instituted within the Planning Unit.
	December	The Office of Female Researcher Development was instituted within the Planning Unit.
2017	January	Survey Science Center and Service Science Research Center were closed.
	July	Data Science Center for Creative Design and Manufacturing was instituted.
	December	The International Affairs Unit were instituted, and the Gender Equality Unit, which had been within the Planning Unit, reorganized within APCS. The Intellectual Property Unit was reorganized as the Industry-Academia Collaboration and Intellectual Property Unit within APCS.
2018	April	Research Center for Medical and Health Data Science was instituted. The NIPR/ISM Joint Administration Office was reorganized as the Tachikawa Administration Department of the Research Organization of Information and Systems (ROIS).
2019	March	Research and Development Center for Data Assimilation was closed.
2021	April	ISM Planning and Coordination Division was instituted within Tachikawa Administration Department.
2022	January	Center for Training Professors in Statistics was instituted.

The Institute of Statistical Mathematics



Access to the ISM

- ◎ Tachikawa Bus
  - — Tachikawa Academic Plaza bus stop
  - — 5 min walk from Saibansho-mae or Tachikawa-Shiyakusho bus stop
- ◎ Tama Monorail
  - —10 min walk from Takamatsu Sta.
- ◎ JR Chuo Line
  - —25 min walk from Tachikawa Sta.

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