2020
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2021

Research Organization of Information and Systems

The Institute of Statistical Mathematics

CONTENTS

Message from Director-General

The Institute of Statistical Mathematics (ISM) celebrated its 75th anniversary on June 5, 2019. On this day, the anniversary ceremony, symposium, Open Campus Day presentation, and other programs targeted at the public were held at the Hitotsubashi Auditorium, Chiyoda-ku, Tokyo, attracting more than 650 attendants. It was a time of cheer, hope, and encouragement. The ISM faculty, researchers, and staff continue to take on new research challenges, expecting that their academic and social contributions will ripple through the data-driven society of the future, when the ISM will celebrate its centennial in 2044.

The world today is seeking an ideal form of a data-driven society in which data are regarded as valuable assets. The advent of a new IT society is gradually transforming people's lives. Statistics sciences help to generate knowledge and value from large bodies of data, expanding the boundaries of academic arenas and socioeconomic activities.

Past Directors-General of the ISM embraced its mission as an Inter-University Research Institute to create cooperative networks of scientists and academic institutions that advance data science and its social applications, as well as contribute to academic excellence, help realize a data-driven society, and nurture the next generation of data scientists. As the 12th Director-General, I will build on those foundations by pursuing the following objectives: (i) Forming a research framework that allows national and international researchers to advance statistical mathematics and other statistical sciences, with the goal of extracting effective knowledge and value management process from data; (ii) Establishing a platform for discovering and sharing the standard scenarios in which a wide array of fields, including statistical mathematics and other statistical sciences, are integrated and applied to the process of knowledge and value extraction; and (iii) Organizing the support system for government–industry–academia collaboration to equip next-generation researchers and data scientists for the era of data science.

The ISM aims to deepen the fundamental mathematics for data science, create and activate research networks, cultivate statisticians, and help visualize their work. Based on those aims, the ISM is currently promoting, in particular, the Network Of Excellence (NOE) Project and a pilot version (Phase 1) of the Data Science Faculty Development Project at the School of Statistical Thinking.

The ongoing global pandemic of Novel Coronavirus Disease 2019 (COVID-19) has made an unprecedented impact on many aspects of our lives. Despite the Japanese Government's declaration of a state of emergency and lockdowns in many other countries, new cases, hospitalizations of patients in serious condition, and death tolls have continued to increase. This suggests that our fight against the virus will be long and uncertain. The ISM is adopting innovative and flexible measures to continue research activities now. I also hope that the outbreak subsides and calm daily life is restored.

The ISM has a long history of research on statistical modeling of infectious disease, and has developed many experts in its simulation. In this difficult time, the ISM has launched a research project about preventing various risks related to COVID-19. We will be happy if we can assist public health experts, epidemiologists, and government officials who are engaged in tackling COVID-19. We cordially ask for your continued support and cooperation.

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, and 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

Risk Analysis Research Center is pursuing a scientific approach to managing uncertainties and risks in society, which have increased with the growing globalization of society and economy. Our research projects are mainly seismology, finance, resources, environmentology, database development and risk mathematics. The Center also manages a network organization for risk analysis to facilitate research collaboration across different organizations with the common goal of creating 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.

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.

The Effort of the Statistical Science towards Solution of Environmental Problems

■ Mission of the project

A risk analysis research center / environmental statistics research project aims at performing the contribution towards solution of the environmental problem which is a modern subject by developing the optimal new statistical methodology for each environmental problem (for example, the problem of dioxin, the problem of global warming, the problem of continuous use of safe water). Moreover, in order to realize this purpose, in cooperation with the community of environmental science, research is carried out including a visiting teacher or a project researcher.

■ Building an international network of environmental statistics

Since 2013, an international symposium ISM Symposium on Environmental Statistics has been held every year at the Institute of Statistical Mathematics, and we have invited key members of The International Environmetrics Society (TIES) as invited speakers. This will contribute to the further development of environmental statistics researchers. We have concluded MOUs with related foreign universities and established an international research network in this field.

■ Statistical approach to risk analysis

It is possible to model the vanishing angles of migratory birds and the orientations of logs on the floor using distributions on the circle. Wind direction is a typical angular variable in environmental science, and it is important to use information on wind direction for a better understanding of, for example, radiation dose and ozone concentration. An angle has a special feature different from a linear variable in mathematics. We study statistical modeling and analysis of data which include angular observations in the framework of directional statistics. We also conduct basic research on probability distributions that play an important role in analysis in the environmental field.

■ Mercury concentration in environmental media and its human health risk observed in artisanal very small gold mining site

The largest source of mercury released into the environment on earth is human-powered small-scale gold mining. Extraction of gold using mercury is popular in developing countries, and there are concerns about its environmental pollution and its impact on human health. In this joint research, we are working on human health risks from inhaled and oral sources using actual fieldwork and statistical analysis methods in the field.

Koji Kanefuji

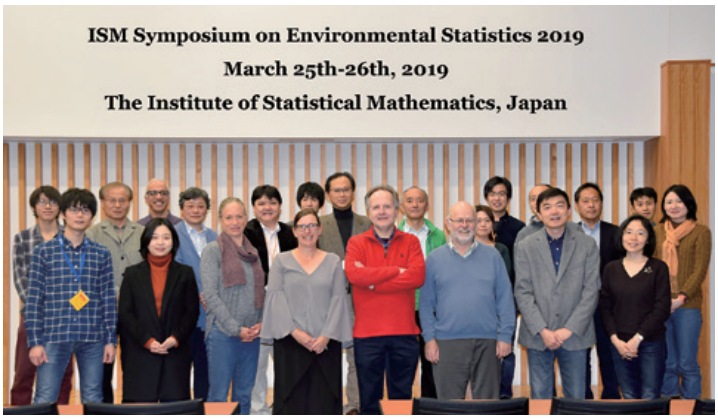


Photo: ISM Symposium on Environmental Statistics 2019.

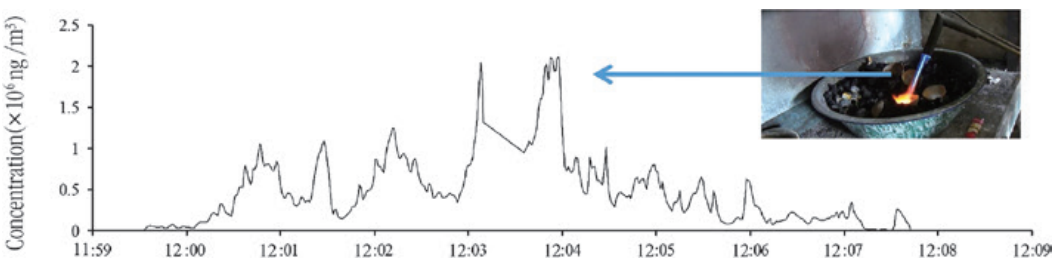


Figure: Mercury concentration in environmental media in micro-scale gold mining and smelting area in Bengkulu, Sumatra, Indonesia.
[by O. Nagafuchi and K. Nakazawa (Fukuoka Institute of Technology)]

Statistical Methods for Multivariate Data with Complex Dependence Structure

■ Risk analysis and multivariate data

For the management of risks such as financial crises and natural disasters, it is often necessary to deal with multivariate data, namely, data comprising of multiple variables. For example, the fluctuations of asset prices of multiple companies can be considered an example of multivariate data. In order to manage the risks related to the portfolio of such fluctuations, statistical methods for multivariate data are useful.

■ Multivariate data with complex dependence structure

Multivariate data observed in practice often have complex relationships between variables or, simply, complex dependence structure. However, many of the statistical methods proposed in the literature are for multivariate data with simple dependence structure. Such methods include the ones based on the multivariate normal distributions.

It is known that statistical methods for data with simple dependence structure could lead to erroneous results if they are fitted to data with complex dependence structure. For example, the fluctuations of asset prices of a company are often heavy-tailed due to financial crises such as Black Monday and Subprime Mortgage Crisis. Therefore it is generally not appropriate to apply the multivariate normal distributions to evaluate the risk of portfolio of such fluctuations (see Figure 1).

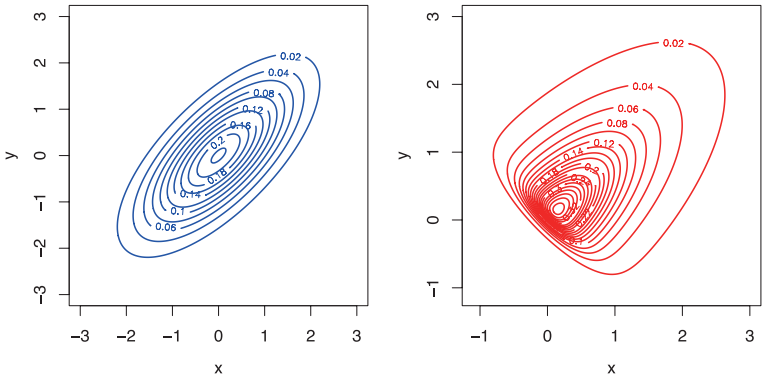


Figure 1: Density of: (left) bivariate normal and (right) skew-Cauchy distributions.

■ Statistical analysis using copulas

Copulas are useful statistical tools for analyzing data with complex dependence structure. Copulas have gained their popularity in recent years as a family of probability distributions for the modelling of non-linear and/or asymmetric multivariate data. Since copulas are distributions which model only the dependence between variables, the marginal distribution of each variable can be selected independently from the copulas. Therefore the joint distribution can be highly flexible and express complex dependence structure. In addition, copulas can be used as scale-free measures of dependence.

As a joint work related to copulas, the author has proposed a copula-based measure to compare the upper and lower tail probabilities of bivariate distributions. Here 'the upper and lower probabilities' are the probabilities that both variables take extremely large and small values, respectively. In our work, it has been seen that the proposed measure has some tractable properties. Figure 2 displays a plot of the proposed measure applied to data on the fluctuations of asset prices. The figure suggests that the values of the proposed measure are small for small values in x-axis, implying that there is asymmetry in tail probabilities in the sense that the lower tail probability is greater than the upper one.

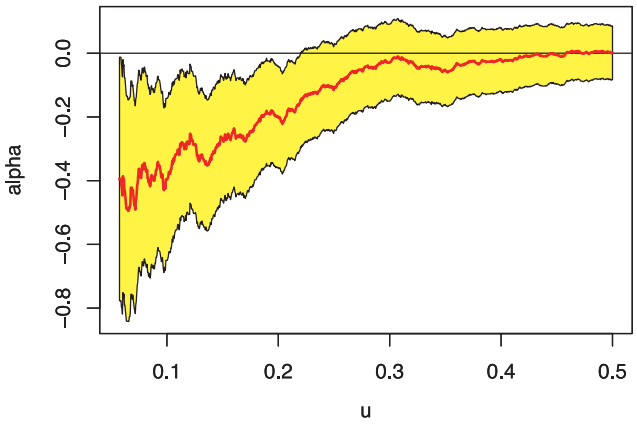


Figure 2: Plot of the values (red) and 90% confidence intervals (yellow) of the proposed measure applied to a financial dataset. The x-axis represents the values of the tuning parameter of the measure, while the y-axis denotes the values of the measure.

Shogo Kato

Data Science Methods for Astronomy

■ Data science and astronomy

Astronomy is one of the oldest sciences. The best technology of each era was used for observation and now modern astronomy is trying to utilize advanced data science methods.

Most of the astronomical observations are detecting electromagnetic waves. Depending on wavelength and each scientific interest, such as nearby planets, galaxies in distance, black holes of galactic nuclei, or cosmology, the required information is different. Thus, there are varieties of demands for data science.

In the last few years, I have been involved in different astronomical projects as a data scientist. In the following, I show two of them.

■ Image of blackhole shadow

On 10 April 2019, in six coordinated press conferences around the world, the first result of the Event Horizon Telescope (EHT) collaboration was released: The shadow of the supermassive black hole of the elliptical galaxy M87 (Figure 1). The estimate of its mass is about 6.5 billion solar mass. Although the size of the hole is about 100 billion km, the apparent size is similar to a tennis ball on the surface of the moon, because it is 55 million light-years far.

EHT is a radio interferometer that combines different radio telescopes. The longest combination was more than 10,000 km and this was the key to the angular resolution. In order to have an image, interferometers need a computational process called "imaging." We have developed two imaging platforms for the EHT. One of them was made by the Japanese group including me. We have utilized "sparse modeling" for our imaging method.

Figure 1: The image of the black hole shadow at the center of the galaxy M87. Credit: Event Horizon Telescope Collaboration.

■ Subaru telescope and type Ia supernovae

Subaru telescope is an optical-infrared telescope at the summit of Maunakea, Hawai'i. Through the survey program, a lot of transient objects have been found. Within those transients, type Ia supernovae are important for cosmology. Since its peak luminosity is consistent, its visual magnitude and redshift tells is the distance and the speed, respectively. Combining these two, the expansion speed of the universe can be estimated.

From the difference of images taken on different days, a lot of candidates for type Ia are found. But most of them are bogus. We have developed a system to find good candidates by combining machine learning methods. With the developed system, we have found 50 good candidates from a single night image (Figure 2).

Shiro Ikeda

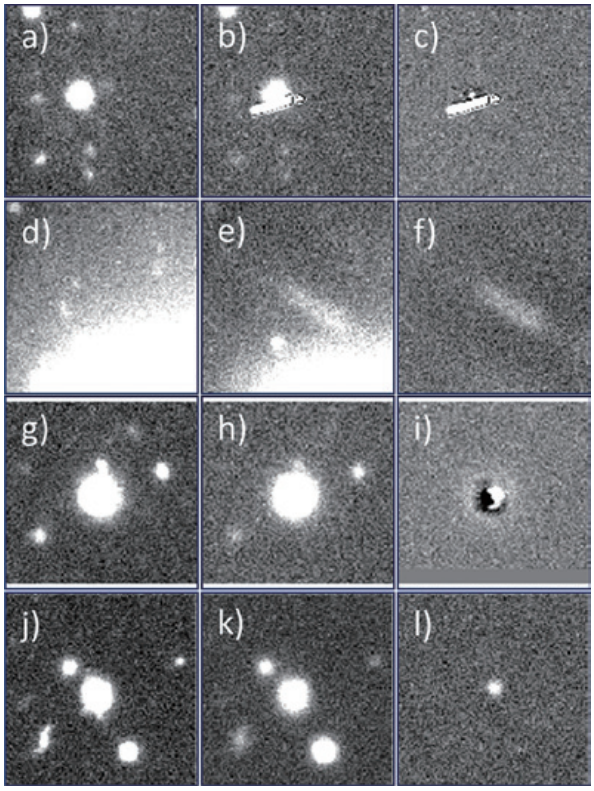


Figure 2: The difference between the left and the middle is the right. The bottom row is a good candidate for a supernova (Morii et al., PASJ, 68(6), 2016, Fig. 1).

Signal Reconstruction by Minimization of Nonconvex Function and Nonconvexity Control

■ Signal reconstruction in compressed sensing

Compressed sensing is a signal reconstruction scheme for when the number of measurements is lower than the number of signal dimensions. This problem setting is underdetermined in general, and the original signal is not uniquely identified. However, prior knowledge that the signal to be reconstructed is sparse sometimes allows perfect reconstruction. A widely used method for signal reconstruction is the ℓ_1 minimization method, which corresponds to the minimization problem of the convex function, which is therefore mathematically tractable. Meanwhile, it is implied that minimization of nonconvex function is more efficient than ℓ_1 minimization. We introduce the nonconvex functions Smoothly Clipped Absolute Deviation (SCAD) and Minimax Concave Penalty (MCP) for signal reconstruction in compressed sensing and analyze their performances. The nonconvexity of these functions is controlled by two parameters called nonconvexity parameters.

■ Theoretical evaluation of performance and approximate message passing

We theoretically verified that SCAD and MCP minimization require a smaller number of measurements than ℓ_1 minimization. In particular, as the nonconvexity is enhanced, signal reconstruction is achieved by a smaller number of measurements. Based on this theory, we introduce an approximate message passing (AMP) algorithm for minimization of nonconvex functions. However, AMP sometimes fails in reconstruction, even when perfect reconstruction is theoretically guaranteed. What is behind this discrepancy?

■ Failure of reconstruction caused by basin of attraction shrinkage

In the case of AMP, the typicality of the trajectories can be described by two macroscopic parameters: mean squared error between true signal and reconstructed signal (ϵ) and variance of the reconstructed signal (V). When the typical trajectory converges to the origin, perfect reconstruction is achieved by AMP. We investigated the trajectories and found that the basin of attraction of the origin shrinks as the nonconvexity increases, and we require initial conditions that are sufficiently close to true signals for perfect reconstruction.

■ Nonconvexity control

A method to resolve the problem is nonconvexity control. When the nonconvex function is close to a convex function, a fixed point, which is not the origin, exists. This fixed point is continuous with respect to the nonconvexity parameter. Therefore, we start AMP with a nonconvex function close to a convex function and approach the origin by slightly increasing the nonconvexity, and finally we reach from the basin of attraction to the origin. We call this method nonconvexity control.

Ayaka Sakata

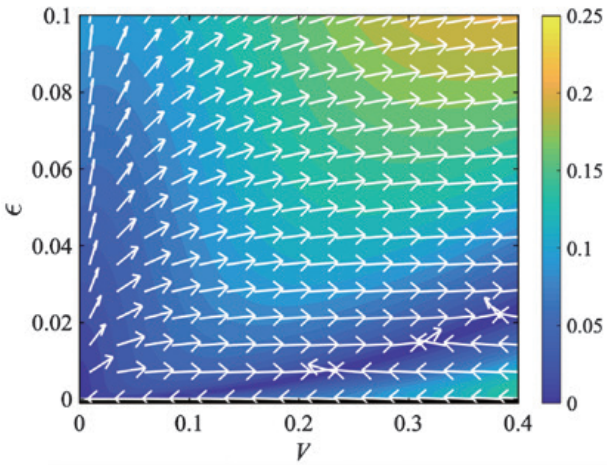


Figure 1: Typical trajectories of AMP for nonconvex function with high nonconvexity. Flow to the origin is restricted to the small ϵ region.

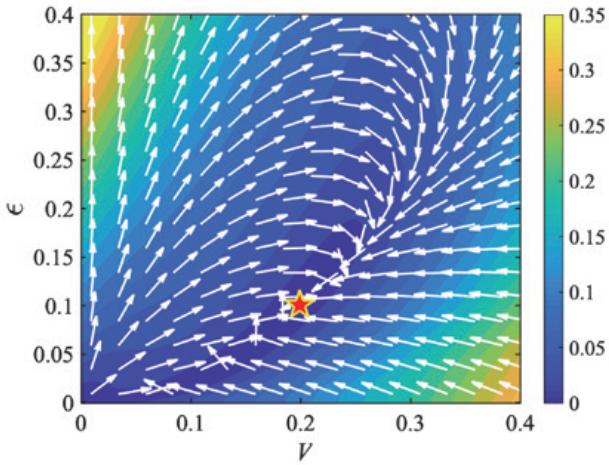


Figure 2: Trajectories of AMP for nonconvex function with low nonconvexity. A fixed point (star) exists.

Data Science for Creative Design and Manufacturing

■ Mission statement

We aim to foster new scientific methodologies 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, resulting in a rapid loss of global predominance in industry. Countries around the world has actively developed their growth strategies utilizing data science as a driving force, such as the Material Genome Initiative in the US and the Industry 4.0. Following the global trend is no longer an effective way to survive in the intensive power game around the world. In 2017, the Institute of Statistical Mathematics has established a new research center - Data Science Center for Creative Design and Manufacturing. We have accumulated state-of-the-art technologies in data science here, for instance, machine learning, Bayesian inference, materials informatics, and so on. We are devoted to foster and practice innovative methods in data science for design and manufacturing through industry-academia collaboration.

■ Smart manufacturing

The developments of new materials depend largely on intuitions of highly experienced professionals, and time-consuming trial-and-error processes for laboratory synthesis and testing of designed materials based on computer simulation and experiments. On the other hand, recently, there are new attempts to substitute computational or real experiments in materials synthesis and testing by statistical models trained by given data. The enormous cost and time required in the characterization of material structures and physical properties have limited material studies within a small set of candidates. For example, it has been proved that high-throughput screening using techniques in data science significantly increases the chance of discovering innovative functional materials. This is a basic concept of smart manufacturing in the perspective of data science.

■ Creative design and manufacturing

We recognize the importance of being at the absolute leading edge position in the manufacturing industry. This cannot be done by data science alone. Most of the tools in data science are designed for interpolative predictions. Data science used to be a science of predictions based on pattern recognition from existing data. For example, we often assume that materials with similar structure exhibit similar physical properties. However, by definition, new materials are unlikely to be similar to any of the existing materials. Combination of experiment, theory and data science methods is an essential step to a new breakthrough in the current state. In other words, we adopt a stepwise approach to expand the region of accurate prediction of a statistical model. We achieve the goal by careful design of an optimal experiment or simulation schedule for new data points that efficiently improve an existing predictive model. We have accomplished preliminary success in material science using an extrapolating prediction method based on a data science approach and fostered new collaboration opportunities between academia and industry for the purpose of new material discovery. Our next step is to extend the application to various fields related to creative design and manufacturing.

Ryo Yoshida

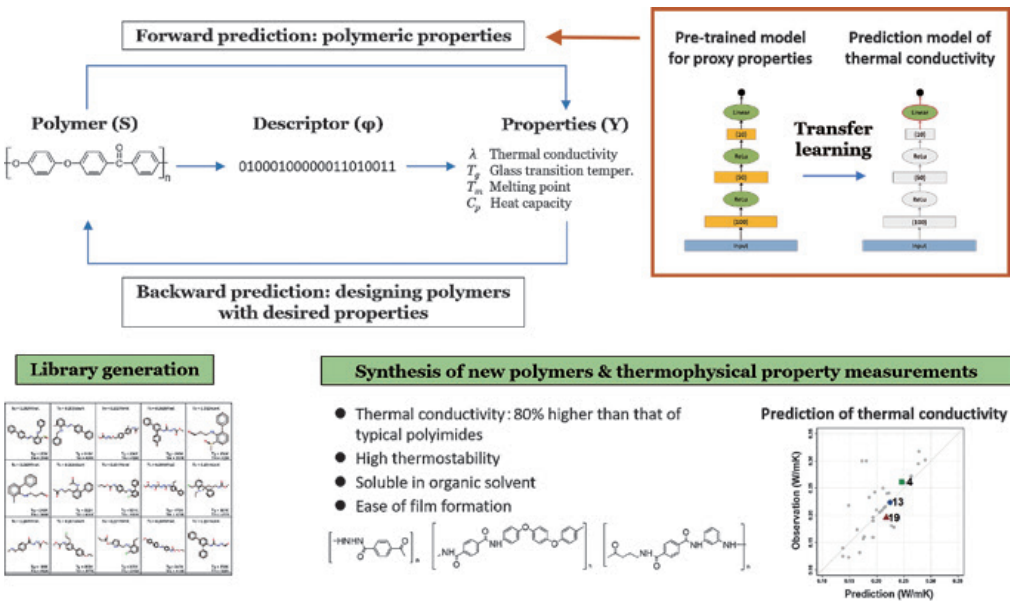


Figure: Discovery of new polymers with high thermal conductivity using machine learning technologies.

Discovery of New Materials Based on Data Science

■ New era of materials informatics

Conventional materials design relies on a trial-and-error process with expert knowledge to manually propose new candidates from existing materials and experimentally/computationally validate the expected material properties of the new designs. Such an approach is not efficient enough to handle the rapidly changing market demand and increasing cost of research and development. Materials informatics (MI), an interdisciplinary field that integrates data science and machine learning methods to accelerate the discovery of high performance novel materials, has emerged to tackle these new challenges. Many national projects around the world have been developed based on the concept of MI. In Japan, for example, a Japan Science and Technology Agency project called the "Materials research by Information Integration" Initiative (MI^2I) were established in 2015 to catalyze the implementation of MI technologies in real world problems. The Data Science Center of Creative Design and Manufacturing in The Institute of Statistical Mathematics has been developing many foundational technologies for MI applications and served as an interactive hub for data scientists and materials scientists.

■ XenonPy: all-in-one open platform for MI

By mapping the highly diverse materials space into a set of "descriptors" and developing a generator of material candidates, we are able to exploit the existing technologies in data science to solve the inverse material design problem. To meet the increasing demand of machine learning tools tailored for various materials sciences applications, our center has developed an all-in-one Python packages, called XenonPy, for different tasks in materials informatics. Furthermore, XenonPy provides free access to over 140,000 pretrained predictive models for more than 45 different properties of organic and inorganic materials.1 This open model library, called XenonPy.MDL, combined with other machine learning modules in XenonPy allows users to customize computational workflows for different material design problems.[1]

■ Extrapolative inverse materials design

XenonPy provides a molecular design algorithm, called iQSPR-X,[2] that continuously modifies a set of molecular structures to new chemically favored structures and picks out the ones with high probability of exhibiting desired material properties. Our center has succeeded in the discovery of new polymers with high thermal conductivity using this algorithm.[3] Furthermore, we are developing SPACIER, a machine learning algorithm that possesses extrapolative power for discovery of truly novel materials. Existing machine learning models are known to be interpolative, i.e., cannot make accurate prediction in the area without any data, which is where the novel materials are. Therefore, integration of experiments or computational simulations with data science is essential to break this bottleneck. SPACIER uses density functional theory to generate computational data. Such data is used to update models in iQSPR-X in order to cover a larger search domain, which will eventually reach the novel materials. We use SPACIER as a proof of concept for successful collaboration between industry and academia in materials science.

Stephen Wu
Yoh Noguchi

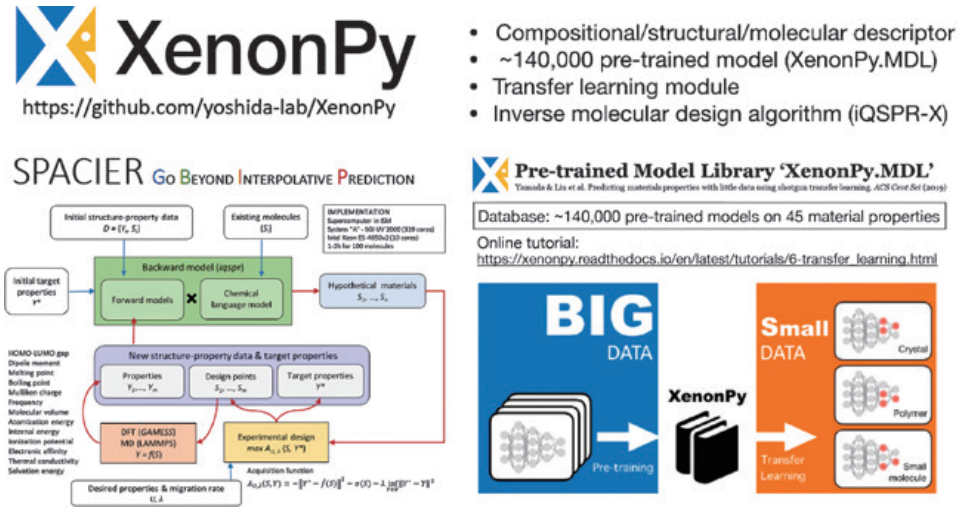


Figure:
An overview of XenonPy's basic features and SPACIER algorithms.

References: 1. Yamada et al. (2019), Predicting materials properties with little data using shotgun transfer learning. ACS Cent. Sci., 5(10):1717-1730.
2. Wu et al. (2019), iQSPR in XenonPy: a Bayesian inverse molecular design algorithm. Mol. Inform.
3. Wu et al. (2019), Machine-learning-assisted discovery of polymers with high thermal conductivity using a molecular design algorithm. npj Comput. Mater., 5:66.

Causal Connectivity Analysis of Respiratory Neural Network

Recording of brain activity by neuroimaging technique

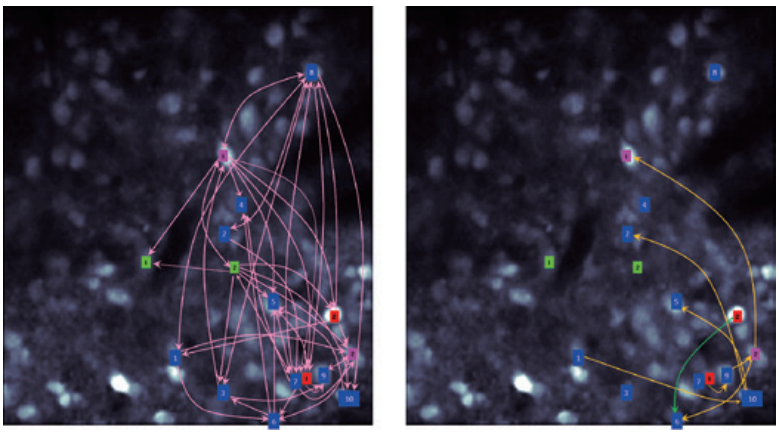
Recent advances in bioimaging technology have made it possible to obtain more than tens of thousands of more accurate spatial information than conventional electrophysiological methods, and to observe spatiotemporal transitions of neuronal activity. However, while the amount of data is enormous, methodological studies to detect neurons related to the event to be investigated and to estimate functional connectivity among neurons have not been well developed.

Research objective

Our group aims to develop a strategy for estimating causal connectivity and network structure between neurons based on spatiotemporal analysis approach and experimental verification of that. There have been studies on mathematical modeling for this purpose, but the reliability of the model has not yet been verified by physiological experiments. We estimate the causal connectivity between neurons that generate respiratory rhythms in the brainstem and examine the mechanism of respiratory rhythm generation from both statistical and experimental approaches.

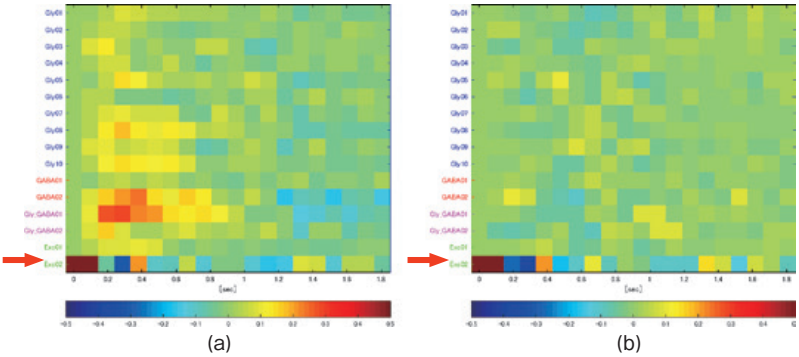
Estimation of neuron network by causal analysis

Applying an autoregressive (AR) model that considers only the activity of a certain neuron and an exogenous variable autoregression (ARX) model with inputs from other neurons, the goodness of fit of the two models can be evaluated by the Akaike Information Criterion (AIC). When this evaluation method is applied to all combinations of neurons, the significant information propagation between neurons that generate the respiratory rhythm can be estimated as shown in Figure 1 (a). In order to assess the estimated neuronal connectivity, we applied an antagonist (CNQX) to block excitatory signals from excitatory neurons. Figure 1 (b) shows results from same analysis of the data measured with the addition of CNQX. Since most of the connectivity has disappeared, it can be said that the possibility of false detection of connectivity between neurons by this analysis method is low, and that the estimated network is likely to exist.



(a) (b)

Figure 1: Estimated neuronal network before (a) and after (b) addition of an antagonist (CNQX).



(a) (b)

Figure 2: Impulse responses from an excitatory neuron (red arrow) to other neurons (Before (a) and after (b) addition of an antagonist (CNQX)).

By using a multivariate autoregressive (VAR) model, it is possible to examine the timing of information propagation between neurons. When an excitatory neuron (red arrow) as an input signal of the optimized VAR, many inhibitory neurons are activated with a delay of about 0.2 seconds (Figure 2).

Currently, we are investigating physiological reasons of the newly appeared connectivity after addition of CNQX (the orange lines in Figure 1 (b)) and developing a method to quantify the significance of neural connectivity. In the future, we are aiming to develop methodological studies to detect non-stationary activated neurons and estimate their time-dependent causality.

Fumikazu Miwakeichi

Risk Factors for Very Low Birth Weight, Term-Small-for-Gestational-Age, or Preterm Birth in Japan

■ Background about gestational age and birth weight in Japan

From 1985 to 2013, the mean birth weight of infants in Japan decreased from 3120 g to 3000 g, and the low-birth-weight rate among live births increased from 6.3% to 9.6%. No prospective study has elucidated the risk factors for poor fetal growth and preterm birth in recent Japanese parents, such as increased parental age, maternal body figure, assisted reproductive technology (ART), and socioeconomic status.

■ Statistical analysis for association between parental characteristics and fetal growth restriction with DAG

Participants were mother–infant pairs (n = 18,059) enrolled in a prospective birth cohort in Hokkaido, Japan from 2002 to 2013. Parental characteristics were obtained via self-reported questionnaires during pregnancy. Medical records helped identify preterm-birth (PTB; <37 weeks), very-low-birth-weight (VLBW; <1500 g), and term-small-for-gestational-age (term-SGA) infants. We calculated relative risks (RRs) for PTB, VLBW, and term-SGA birth based on parental characteristics. The relative risks (RR) of VLBW, term-SGA, and PTB according to parental characteristics were estimated using multiple Generalized Linear Models. A directed acyclic graph (DAG) was constructed to identify a minimum set of confounding adjustment (Figure 1). We selected the set of covariates for each factor that were regarded as the main exposure to effect on RRs of outcome such as VLBW, term-SGA, and PTB.

■ Results for RRs for PTB, VLBW, and term-SGA birth based on parental characteristics

The prevalence of PTB, VLBW, and term-SGA was 4.5%, 0.4%, and 6.5%, respectively. Aged parents and ART were risk factors for PTB and VLBW (Figure 2). Maternal alcohol drinking during pregnancy increased the risk; a parental educational level of 16 years reduced risk of term-SGA. Maternal pre-pregnancy BMI of <18.5 kg/m^2 increased the risk of PTB and term-SGA. The RR for low BMI was highest among mothers who have low educational level. Among various factors, appropriate nutritional education to maintain normal BMI is important to prevent PTB and term-SGA in Japan.

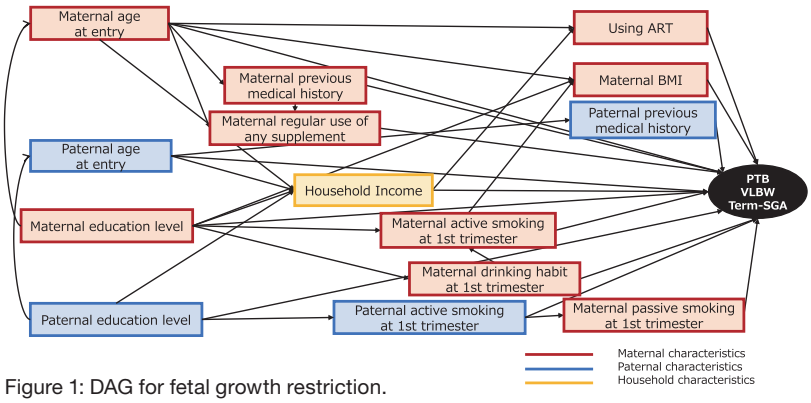


Figure 1: DAG for fetal growth restriction.

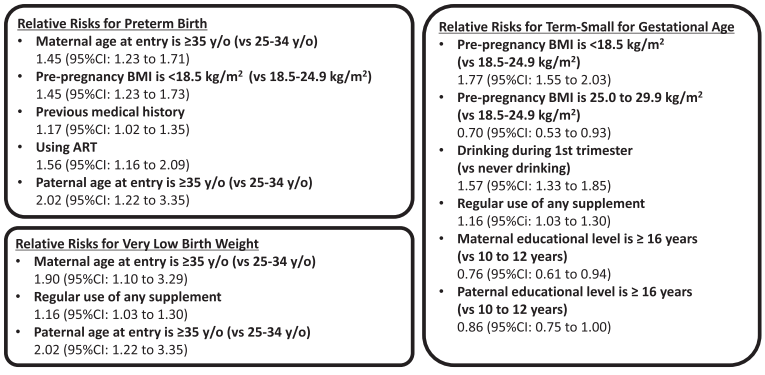


Figure 2: Significantly relative risks for fetal growth restriction with parental characteristics.

This is collaborative study with Hokkaido Study of Environment and Children's Health conducted by Center for Environmental and Health Sciences, Hokkaido University.

Naomi Tamura

Reference:
Naomi Tamura, et al. Parental risk factors for infants being preterm, very low birth weight, or term-small for gestational age in Japan. International Journal of Environmental Research and Public Health 2018, 15(2), 369.

Estimation of Animal Behavior

■ Movement modeling of animals

Understanding of spatial utilization of animals is essential to promote biodiversity conservation, animal damage control, and dispersion control of invasive species effectively. Each species has species-specific environmental preferences (i.e. ecological niche). Based on this premise, the probabilities of species distribution and abundance have been estimated using species-environment relationships (i.e. habitat modeling: Figure 1). However, animals usually exhibit high spatial mobility, and, therefore, it is also required to grasp their dynamic movement between habitats for efficient conservation and management initiatives. Recently, small animal-borne data loggers have been widely applied to record behavior of animals (called Bio-Logging). On the other hand, while current status of given species can be examined using this method, predicting how environmental alterations caused by climate change and environmental degradation affect them is still obscured. So, to estimate movement of animals, I try to develop a movement model by incorporating their behavioral transition probabilities in relation to environmental stimuli (e.g. stay, evasion, inversion), optimized by data assimilation method using GPS tracking data.

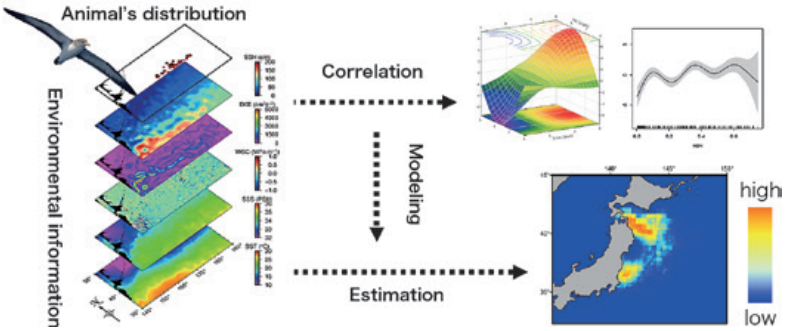


Figure 1: Overview of habitat modeling, which estimate probable distribution and abundance of animals by species-environment relationships (Yamamoto et al. 2015 Ecological Applications).

■ Understanding the human-wildlife conflict

Recently, we published new study, showing the human-wildlife conflict by estimating seasonal movement of animals. Magellanic penguins breed along the coasts of Chile and Argentina, and they are listed as nearly endangered. The population of this species has been declined, which is presumed to relate to high mortality of females during non-breeding season. However, their behavior during this period has been unknown. So, in collaboration with CONICET (National Scientific and Technical Research Council, Argentina), we examined seasonal movement of penguins during the non-breeding period using a data logger. In this study, we used a data logger that can record light intensities over a year, and estimated probable positions based on day length and the timing of local noon with respect to GMT. As a result, we found that at-sea distributions differed between sexes, and wintering area of females was overlapped with areas of man-made threats, including oil development, marine transport, and fishery-associated hazards (Figure 2). This research was released in EurekAlert! officially by the published journal (Current Biology) and received attention worldwide.

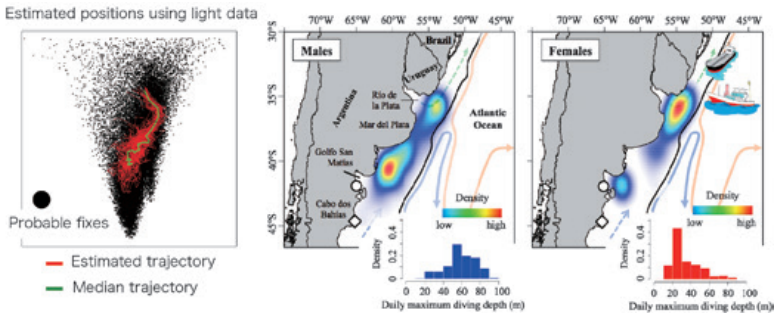


Figure 2: An example of probable trajectory estimated using light intensity data (left) and at-sea distribution of male and female penguins during the non-breeding period (right). Females occupied areas with man-made threats (Yamamoto et al. 2019 Current Biology).

■ New approach for animal behavior monitoring

Behavioral observation is one of important methods to assess an animal's quality of life, reared at farms and zoos. However, long-term and continuous observation of animals is not easy to do, and also number of individuals observed is limited. In collaboration with zoos and aquariums in Japan, I have been recording acceleration of animals using a data logger, and applied time-series analysis (e.g. hidden Markov model) to estimate hidden state (i.e. behavior) to establish low time- and effort-consuming monitoring approach.

Takashi Yamamoto

Visitor Studies in Science Communication for Developing Survey Methodologies

■ Institutional public communication of science

Ministry of Education, Culture, Sports, Science, and Technology has recommended the promotion of science communication activities since its Third Science and Technology Basic Plan. The majority of universities and research institutions have responded by holding events such as open houses to facilitate active dissemination of scientific information. The question remains as to how the opportunity to receive such scientific experience is distributed among the citizens[1]. Those who do not take the opportunities offered will not receive them. Who are the actual citizens attending open house events at scientific research institutions, and how they are distinctive from general Japanese public?

■ Statistical comparison of visitor surveys and nationally representative surveys

The statistical comparison of visitor surveys of the open houses and nationally representative surveys including Japanese National Character Survey is an effective approach of answering the above question. We found that as compared to the general Japanese public, participants of science communication activities believed highly in the value of scientific research and have greater amount of cultural capital not only science and technology but also literature and art. However, we did not observe any statistical differences with regard to their assessment of the level of science, art, or the economy in Japan.[2]

■ Elaboration of survey methodologies with visitor studies research

Visitor surveys have many potentials for contributing development of survey methodologies. This study uses different measurement methods of visitors' exhibit-viewing behaviors such as questionnaires and smart card records to examine the reliability and validity of the measurements (Figure 1).[2] Because the purpose of visitor surveys was not always exclusively research use, they may contain noise in the measurements of exhibit viewing behaviors. For example, visitors were incentivized to use smart cards to participate in a bingo game (Figure 2) and such incentives may influence measurements of total exhibit-viewing time and total number of exhibits viewed. Further utilizing such drawbacks including effects of noise, we aim to contribute to elaboration of survey methodologies by combining multiple methods of measurement (Table 1).

Naoko Kato-Nitta

Figure 1:
The smart card (Felica system) used to measure exhibit-viewing behaviors.

Figure 2: Touching the electric card at a checkpoint at participating in an exhibit.

		Group 1	Group 2	Group 3	**Group 4**	*Max*	*Min*	*M*	*SD*
Questionnaire	*M*	13.2	23.0	36.5	**12.4**				
	Max	22.8	27.8	41.7	**31.3**	50	1	19.6	9.8
	Min	3.9	18.6	30.7	**3.5**				
Smart Card	*M*	12.5	22.6	31.3	**3.8**				
	Max	16.3	23.6	32.6	**5.7**	35	0	22.2	9.0
	Min	6.5	21.5	30.0	**1.7**				
Propertion		9.5%	47.4%	29.5%	**13.6%**				
Character		Low	Mediium	High	**Stop**				
n				394					

Table 1. Estimating mixed distributions using a normal mixture model: There was a group of people who stopped touching their smart cards halfway through even though they claimed to have viewed more of the exhibits in the questionnaire.

References:
1. Kato-Nitta, N. (2013). *Public Understanding of Science*, 22(3), 321-334.
2. Kato-Nitta, N., Maeda, T., Iwahashi, K., & Tachikawa, M. (2018). *Public Understanding of Science*, 27(7), 857-875.

Building a Framework for Advancing Strategic Research and Pursuing a New Approach to Collaborative Research

■ 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 four NOE-research centers and one school 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 mathematics 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. All tenured research staff in ISM are assigned in principle to one of these basic research departments. 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 mathematics.

On the other hand, the NOE-type research centers and the school (along the vertical axis) are staffed by permanent researchers within ISM, project professors/researchers (post-doctoral researchers), and visiting professors and researchers. There are four NOE-type research centers: the Risk Analysis Research Center (RARC), the Research Center for Statistical Machine Learning, the Data Science Center for Creative Design and Manufacturing (DSCCDM), and the Research Center for Medical and Health Data Science (RCMHDS). These centers conduct research activities that interface statistical mathematics with individual scientific disciplines in order to find solutions to urgent social problems. And the School of Statistical Thinking is for professional development. Please refer to the page “Project of Fostering and Promoting Statistical Thinking” for more details.

■ History of the NOE Project

In accordance with the second medium-term plan for Research Organization of Information and Systems (ROIS, ISM’s parent organization), ISM had set as a goal the establishment of NOEs (Networks Of Excellence) in statistical mathematics. Initially, ISM established NOEs in Risk Research, Next-Generation Simulation, Survey Science, Statistical Machine Learning, and Service Science. Over the next few years, however, ISM reorganized the domains of NOEs or NOE-type Research Centers considering the needs of each community as well as modern society as a whole. We closed the Survey Science Center in FY 2016. Its projects were transferred to one of the centers in the Joint Support Center for Data Science (DS) of ROIS. Survey Science Group at the Dept. of Statistical Data Science, which is now the core organization, is responsible for connecting and establishing the Survey Science NOE. The Service Science Research Center was

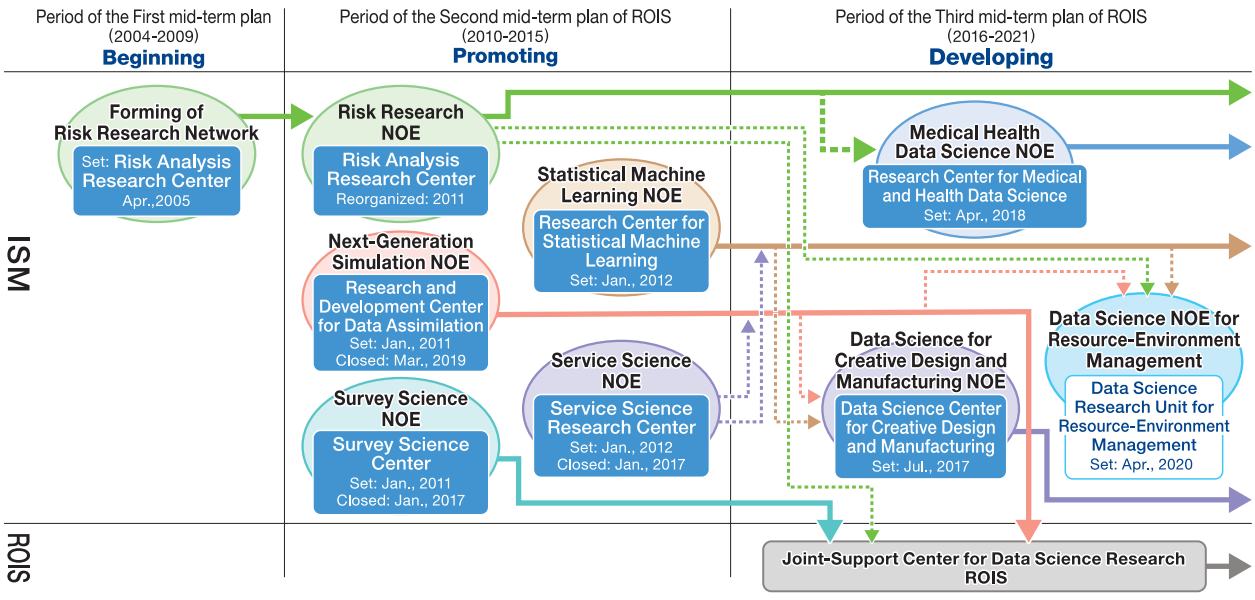


Fig. 1: Brief history of the NOE (Network Of Excellence) Project.

also closed in FY 2016, and its projects were distributed to other Centers according to their methodologies. In July 2017, ISM launched DSCCDM, and also established the Data Science for Creative Design and Manufacturing NOE, which inherited a part of the Service Science NOE. RCMHDS was set up in April 2018. The Center, which was launched from one of the projects of RARC, is promoting research and educational activities in medical health data science domains based on the knowledge and networks that ISM obtained in statistical mathematics both inside and outside Japan (Fig. 1). The Research and Development Center for Data Assimilation was also closed at the end of FY 2018. Each project has been transferred to another center in DS, like the Survey Science Center. The Data Assimilation Group at the Dept. of Statistical Modeling in ISM has inherited the establishment of the Next-Generation Simulation NOE. This April, we formally set up the new NOE domain and its research unit, Data Science for Resource-Environment Management. As of this FY, ISM is promoting projects with seven NOE domains: Risk Research, Next-Generation Simulation, Survey Science, Statistical Machine Learning, Data Science for Creative Design and Manufacturing, Medical and Health Data Science, and Data Science for Resource-Environment Management (Fig. 2).

■ Future Perspective of NOE Activities

This NOE Project is a core theme of ISM. To fulfill the goal of establishing new scientific methodologies 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. The 3rd Advisory Board Meeting of the NOE Project was held on December 17, 2019. All six members of the board in each research domain attended the meeting and engaged in discussion with core members of the project at ISM.

On the basis of this project, ISM, as an Inter-University Research Institute, will be providing the industrial, academic, and government communities with further opportunities for joint usage (of facilities) and joint research. This project, made possible by ISM's special focus in the cross-disciplinary field of statistical mathematics, is attracting strong support from each of these communities. As described above, each NOE-type research center serves as a core hub in its respective fields. The number of ISM's Memoranda of Understanding with research organizations within Japan and overseas is increasing each year, including many that span multiple research fields. ISM's general research in statistical mathematics, which is in demand by various research fields in both the humanities and sciences, could connect existing fields and create new research fields. Hence, ISM plans for the NOEs to become broader, not only in statistical mathematics but also in data science. ISM is continuously expanding and developing this NOE project with the aim of establishing new scientific methodologies ("Fourth Paradigm"), creating new research disciplines, and developing new styles of joint research. 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/

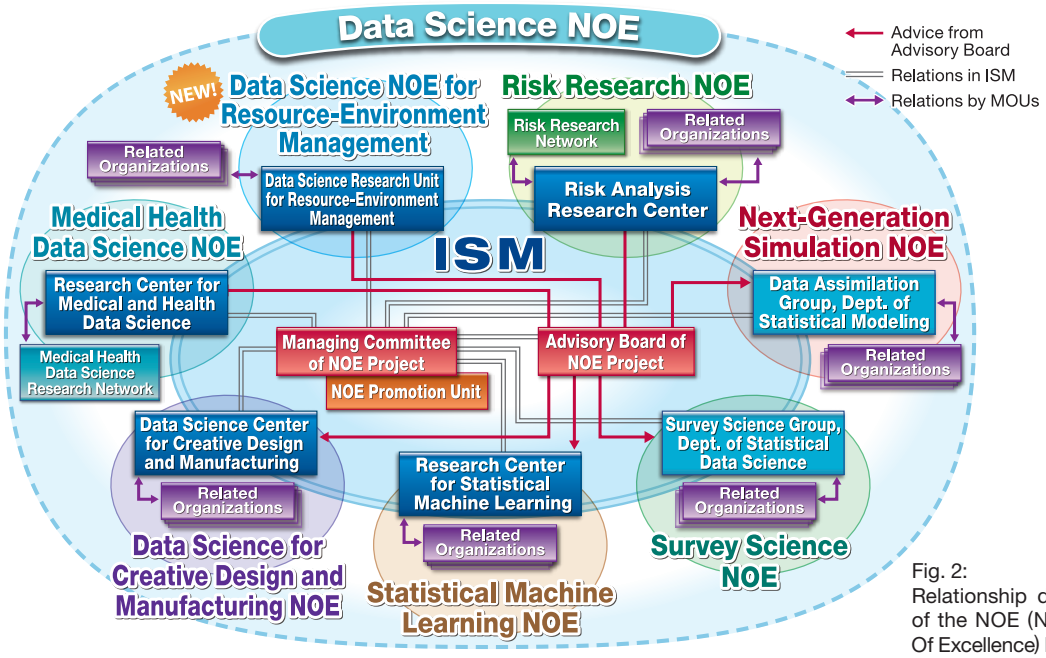


Fig. 2:
Relationship diagram of the NOE (Network Of Excellence) Project.

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. 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 more than 30 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.

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 free to attend. 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

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 2019, five workshops have been accepted after review.

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 2019, we organized three Leading DAT lectures entitled "L-A Introductory Data Science", "L-B1 An Introduction to Statistical Modeling" and "L-B2 Machine Learning and Modern Methodologies in Data Science". Around half of the attendants of L-B1 and L-B2 enroll the Leading DAT Training Course, in which we grant certificates to participants who have fulfilled the course requirements, including attendance in L-B1 and L-B2 lectures and submission of reports. A total of 44 people have been granted the certificate of completion.

Group photo of attendees to the Leading DAT Training Course

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 2019, 9 lectures and one course (including Leading DAT) were held and the number of participants was 878. The total numbers of lectures and courses held from 1969 to March, 2020 were 382 and 3 respectively, with a total of 27,899 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

International Cooperation

Associated Foreign Research Institutes

Organization name	Address	Conclusion day
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
Le laboratoire de mathématiques de l'Universite Blaise Pascal	France (Clermont-Ferrand)	February 11, 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
The Chancellor masters and Scholars of the University of Oxford	The United Kingdom (Oxford)	March 10, 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
University of Malaya	Malaysia (Kuala Lumpur)	September 18, 2017
Unversidade de Évola	Portugal (Evola)	November 30, 2017
Universität Ulm	Germany (Ulm)	December 8, 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
National University of Singapore Konrad-Zuse-Zentrum für Informationstechnik Berlin	Singapore Germany (Berlin)	February 25, 2020
Singapore-ETH Centre	Singapore	March 18, 2020

*There are two more agreements concluded.

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	2014	2015	2016	2017	2018	2019
Number of Activities	177	183	187	161	166	178

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

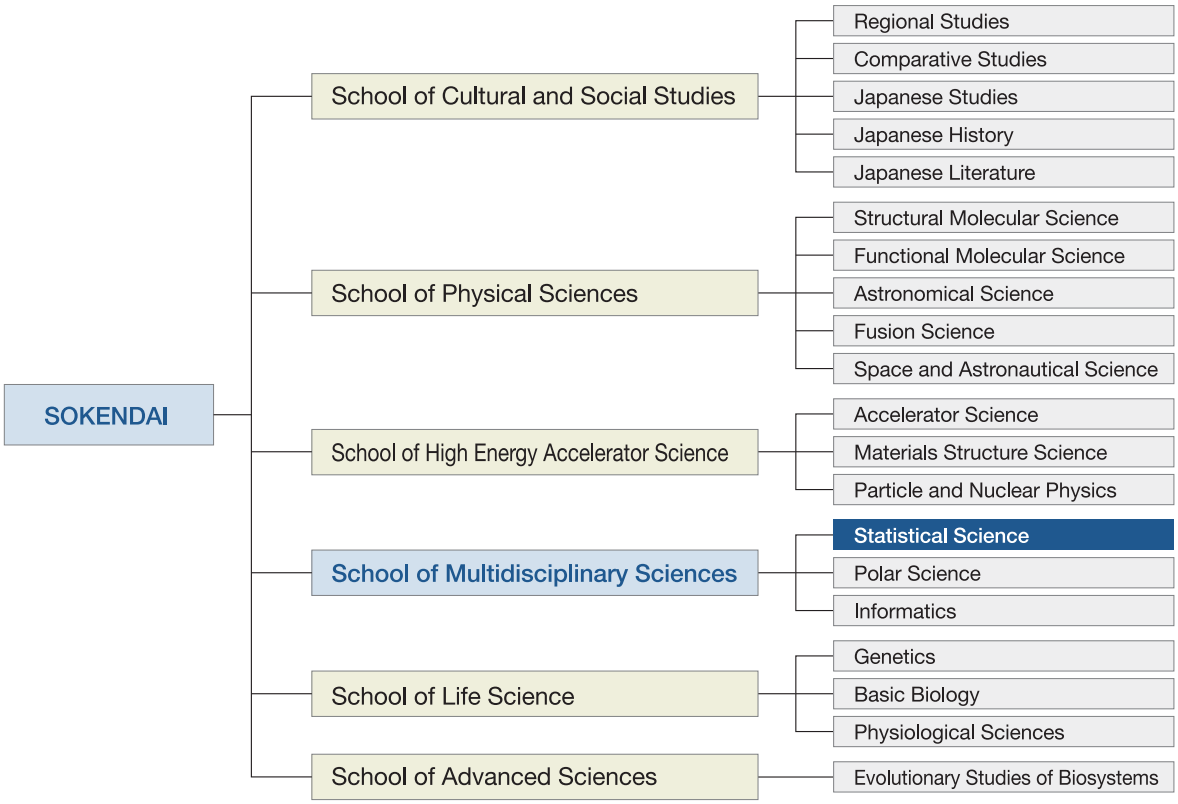
Major Research Fields

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.



Outline of Education and Research

The Department of Statistical Science, 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 Department 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	Education and research focuses 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

- The course is the only integrated doctoral program on statistical science in Japan. It has received students from a wide variety of disciplines and has offered education and research on statistical science by professors specialized in many different fields, from theory through to practical applications.
- The Institute of Statistical Mathematics, the platform for the course, is equipped with a world-class super computer, high-speed 3D graphic computers and simulators to generate physical random numbers, as well as a variety of software, including original statistical software developed by the Institute.
- The academic publications and books on statistical and mathematical sciences produced are some of the best in the world.
- In its role as an inter-university research institute, the Institute holds frequent workshops and seminars by visiting professors and researchers from both Japan and abroad. Students are free to attend and participate.
- It is possible to collaborate with researchers from other universities and institutions. It is also possible for students to develop their own projects by participating in research projects with other institutions.

Course Requirements and Type of Degree Granted

- Requirements to complete the doctoral course are as follows:
  Completion of at least 40 credits, including the required ones, by a student in the five-year program, or completion of at least 10 credits by a three-year doctorate student who previously completed a Master's course; meeting all the criteria set by the thesis committee of the Institute; and successfully completing the examination.
- On completion of the course, either a Doctorate in Statistical Science or, if the thesis deals mainly with an inter-disciplinary field related to statistical science, a Doctorate of Philosophy is awarded.
- The required number of years of study will be flexible if a student demonstrates outstanding research results.

Number of Students (As of April 1, 2020)

■ 5-year doctoral course:Quota,2

Year of enrollment	2013	2016	2017	2018	2019	2020
Number of students	1	1	1	1	2	0

■ 3-year doctoral course:Quota,3

Year of enrollment	2015	2016	2017	2018	2019	2020
Number of students	1 ①	4 ③	3 ③	7 ⑤	15 ⑫	3 ①

* 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 (4) • Fukushima University (1) • University of Tsukuba (7) • 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 (22) • Tokyo Metropolitan University (1) • Tokyo University of Agriculture and Technology (1) • Hitotsubashi University (6) • Shizuoka University (1) • Kanazawa University (1) • Japan Advanced Institute of Science and Technology (1) • Nagoya University (4) • Toyohashi University of Technology (2) • Kyoto University (7) • Osaka City University (1) • Osaka University (3) • Nara Institute of Science and Technology (1) • Okayama University (2) • Shimane University (3) • Kyushu University (3) • Oita University (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)

Degrees Awarded

Year	2013	2014	2015	2016	2017	2018	2019
Doctor of Philosophy	6	5	5	7	5	5	5

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)

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

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.

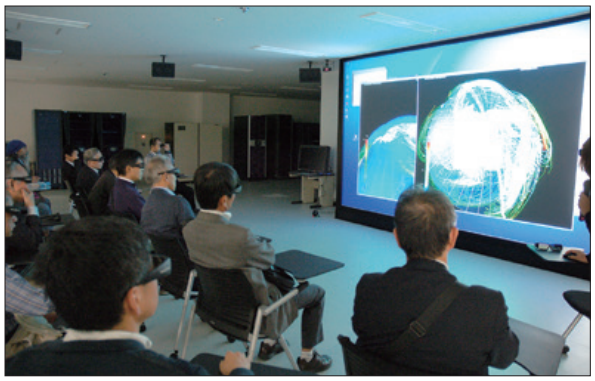
Facilities and Equipment

Computational Resources (As of April 1, 2020)

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 petaflops. The system is liquid cooled and consists of 384 compute 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. For visual representation of research results, ISM has a 200-inch wide screen and a projector capable of showing 3D movies in 4K resolution in the historical computers exhibit room.

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 SINET5 (40 Gbps).

Supercomputer System for Statistical Science (HPE SGI 8600)



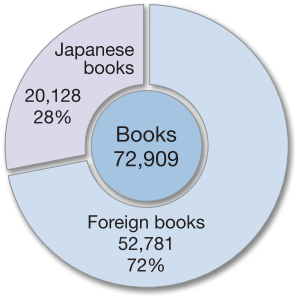
200-inch wide screen showing 3D movies in 4K resolution

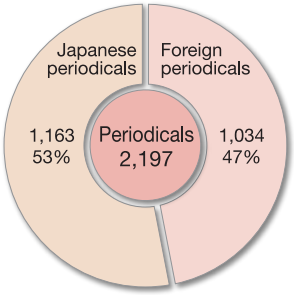
Library and Materials (As of April 1, 2020)

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 (2019)

Type	Personnel expenses	Non-personnel expenses	Total
Expenditure	664,233	921,088	1,585,321

Unit: 1,000JPY

Accepted External Funds (2019)

Type	Joint research	Subcontracted research, Trustee business	Academic Consulting	Contract researchers	Contribution for scholarship	Total
Items	24	26	7	1	8	66
Income	55,273	134,900	5,815	279	9,390	205,657

Unit: 1,000JPY

Grant-in-Aid for Scientific Research "KAKENHI" (2019)

Research Category	Items	Amount Granted
Grant-in-Aid for Scientific Research on Innovation Areas	1	14,820
Grant-in-Aid for Scientific Research (S)	—	—
Grant-in-Aid for Scientific Research (A)	6	50,960
Grant-in-Aid for Scientific Research (B)	7	32,110
Grant-in-Aid for Scientific Research (C)	22	26,910
Grant-in-Aid for Challenging Research (Exploratory)	3	4,680
Grant-in-Aid for Young Scientists (B)	5	6,554
Grant-in-Aid for Early-Career Scientists	8	9,490
Grant-in-Aid for Research Activity Start-up	1	1,430
Grant-in-Aid for JSPS Fellows	1	910
Grant-in-Aid for Publication of Scientific Research Results	1	789
Total	55	148,652

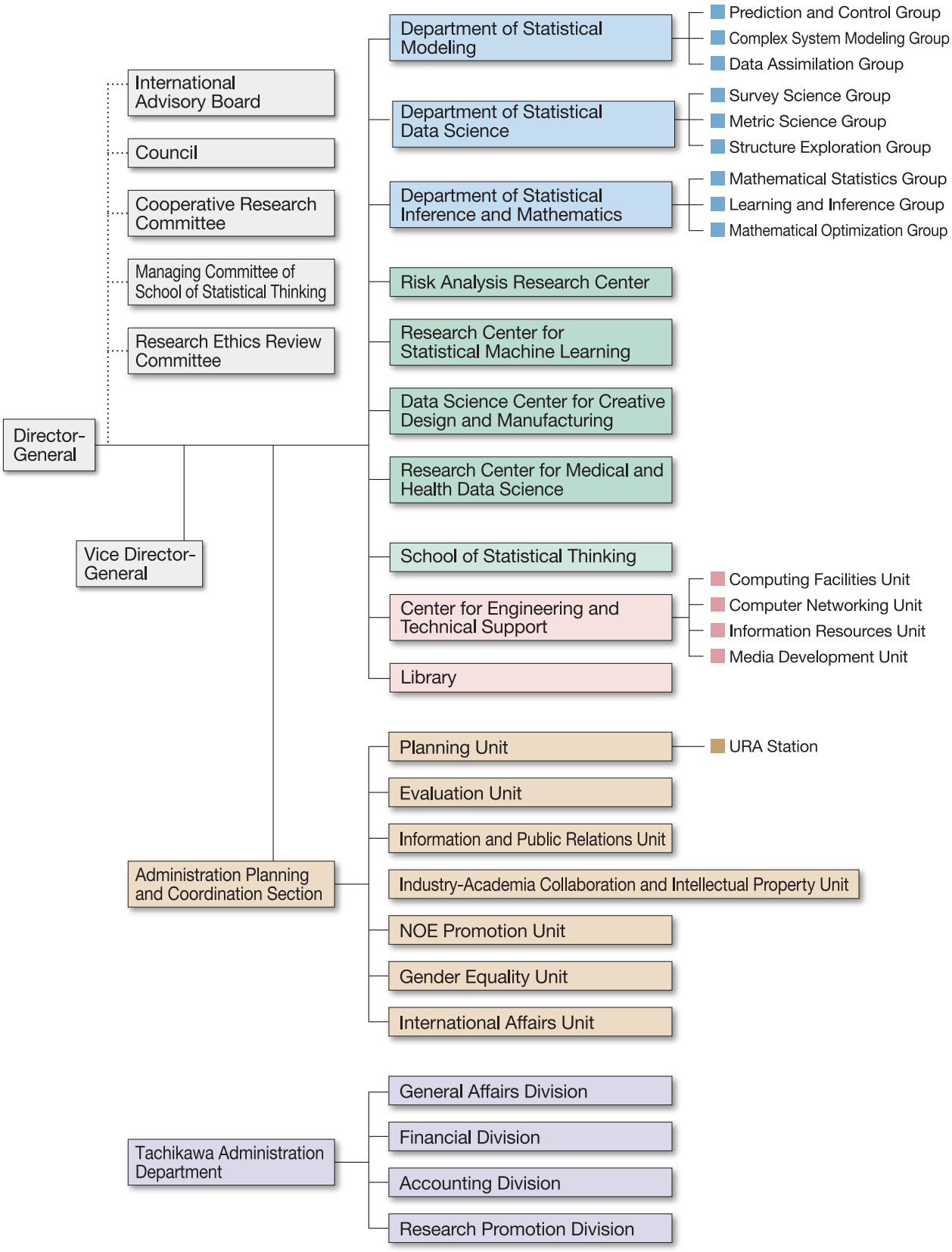
Unit: 1,000JPY

Site and Buildings (As of April 1, 2020)

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

Organization

Organization Diagram (As of April 1, 2020)



Number of Staff (As of April 1, 2020)

Type	Director-General	Professor	Associate Professor	Assistant Professor	Administrative Staff	Technical Staff	Total
Director-General	1						1
Department of Statistical Modeling		7	5	1			13
Department of Statistical Data Science		4	7	2			13
Department of Statistical Inference and Mathematics		7	8				15
School of Statistical Thinking							0
Center for Engineering and Technical Support						10	10
Administration Planning and Coordination Section					1		1
Tachikawa Administration Department					(35)	(1)	(36)
Total	1	18	20	3	1(35)	10(1)	53(36)

( ) 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 two each staff member who retired because of age but was reemployed in a different position.

Staff (As of August 1, 2020)

Director-General	Hiroe TSUBAKI				
Vice Director-General	Satoshi ITO	Vice Director-General	Satoshi YAMASHITA	Vice Director-General	Yoshihiko MIYASATO

Department of Statistical Modeling

Director Tomoko MATSUI

Prediction and Control Group

Prof.	Yoshinori KAWASAKI	Prof.	Yoshihiko MIYASATO	Prof.	Atsushi YOSHIMOTO
Assoc. Prof.	Jiancang ZHUANG	Assoc. Prof.	Yumi TAKIZAWA	Assoc. Prof.	Fumikazu MIWAKEICHI

Complex System Modeling Group

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

Data Assimilation Group

Prof.	Genta UENO	Assoc. Prof.	Shinya NAKANO	Assist. Prof.	Shunichi NOMURA
Visiting Prof.	Shinichi OTANI	Visiting Prof.	Masako KAMIYAMA	Visiting Prof.	Tadahiko SATO
Visiting Prof.	Kazuyuki NAKAMURA	Visiting Prof.	Tomoyuki HIGUCHI	Visiting Assoc. Prof.	Hiroshi KATO
Visiting Assoc. Prof.	Hiromichi NAGAO	Visiting Assoc. Prof.	Yosuke FUJII	Visiting Assoc. Prof.	Masaya SAITO

Department of Statistical Data Science

Director Koji KANEFUJI

Survey Science Group

Prof.	Kazuhiro MINAMI	Assoc. Prof.	Tadahiko MAEDA	Assoc. Prof.	Yoo Sung PARK
Project Assist. Prof.	Kiyohisa SHIBAI	Project Assist. Prof.	Le Duc ANH	Project Assist. Prof.	Naoko KATO

Staff

Department of Statistical Data Science

Visiting Prof.	Takatoshi IMADA	Visiting Prof.	Toru KIKKAWA	Visiting Prof.	Yoshimichi SATO
Visiting Prof.	Wataru MATSUMOTO	Visiting Prof.	Kazufumi MANABE	Visiting Prof.	Masahiro MIZUTA
Visiting Assoc. Prof.	Koken OZAKI	Visiting Assoc. Prof.	Taisuke FUJITA	Visiting Assoc. Prof.	Yusuke INAGAKI

Metric Science Group

Prof.	Satoshi YAMASHITA	Prof.	Koji KANEFUJI	Prof.	Shigeyuki MATSUI
Assoc. Prof.	Ikuko FUNATOGAWA	Assoc. Prof.	Hisashi NOMA	Assist. Prof.	Nobuo SHIMIZU
Project Researcher	Hiroka HAMADA				

Structure Exploration Group

Prof.	Ryo YOSHIDA	Assoc. Prof.	Jun ADACHI	Assoc. Prof.	Kenichiro SHIMATANI
Assoc. Prof.	Stephen WU	Assist. Prof.	Daisuke MURAKAMI		

Department of Statistical Inference and Mathematics

Director Satoshi KURIKI

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.	Akimichi TAKEMURA	Visiting Prof.	Nobuaki HOSHINO		

Learning and Inference Group

Prof.	Kenji FUKUMIZU	Prof.	Hironori FUJISAWA	Assoc. Prof.	Daichi MOCHIHASHI
Assoc. Prof.	Masayuki HENMI	Assoc. Prof.	Ayaka SAKATA		

Mathematical Optimization Group

Prof.	Satoshi ITO	Prof.	Shiro IKEDA	Assoc. Prof.	Mirai TANAKA
Assoc. Prof.	Bruno FIGUEIRA LOURENÇO	Visiting Prof.	Eitaro AIYOSHI	Visiting Prof.	Kazuo MUROTA

Risk Analysis Research Center

Director Satoshi YAMASHITA Vice Director Shogo KATO

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
Assoc. Prof.	Masayuki HENMI	Assoc. Prof.	Jiancang ZHUANG	Assoc. Prof.	Kenichiro SHIMATANI
Assoc. Prof.	Shogo KATO	Assoc. Prof.	Yumi TAKIZAWA	Assoc. Prof.	Takaaki SHIMURA
Assoc. Prof.	Stephen WU	Project Assoc. Prof.	Masayuki KUMON	Assist. Prof.	Shunichi NOMURA
Assist. Prof.	Daisuke MURAKAMI	Project Assist. Prof.	Junchao ZHANG	Project Assist. Prof.	Hideaki NAGAHATA
Visiting Prof.	Masakazu ANDO	Visiting Prof.	Masao UEKI	Visiting Prof.	Tadashi ONO
Visiting Prof.	Takashi KAMEYA	Visiting Prof.	Toshikazu KITANO	Visiting Prof.	Naoto KUNITOMO
Visiting Prof.	Naoki SAKAI	Visiting Prof.	Yo SHINA	Visiting Prof.	Yasutaka SHIMIZU
Visiting Prof.	Rinya TAKAHASHI	Visiting Prof.	Satoshi TAKIZAWA	Visiting Prof.	Hideatsu TSUKAHARA
Visiting Prof.	Hiroshi TSUDA	Visiting Prof.	Tetsuji TONDA	Visiting Prof.	Shunji HASHIMOTO

Risk Analysis Research Center

Visiting Prof.	Hisayuki HARA	Visiting Prof.	Masaaki FUKASAWA	Visiting Prof.	Satoshi FUJII
Visiting Prof.	Toshihiro HORIGUCHI	Visiting Prof.	Toshio HONDA	Visiting Prof.	Mihoko MINAMI
Visiting Prof.	Yoshiki YAMAGATA	Visiting Prof.	Nakahiro YOSHIDA	Visiting Prof.	Toshinao YOSHIBA
Visiting Prof.	Takaaki YOSHINO	Visiting Prof.	Sadaaki MIYAMOTO	Visiting Prof.	Shinsuke ITO
Visiting Prof.	Hitoshi MOTOYAMA	Visiting Prof.	Kazuyuki SUZUKI	Visiting Assoc. Prof.	Takaki IWATA
Visiting Assoc. Prof.	Bogdan Dumitru ENESCU	Visiting Assoc. Prof.	Yukihiko OKADA	Visiting Assoc. Prof.	Teppei OGIHARA
Visiting Assoc. Prof.	Kenichi KAMO	Visiting Assoc. Prof.	Yuta KOIKE	Visiting Assoc. Prof.	Masashi KONOSHIMA
Visiting Assoc. Prof.	Junichi TAKAHASHI	Visiting Assoc. Prof.	Isao TAKABE	Visiting Assoc. Prof.	Dou XIAOLING
Visiting Assoc. Prof.	Seisho SATO	Visiting Assoc. Prof.	Kazuyoshi NANJO	Visiting Assoc. Prof.	Takafumi KUBOTA
Visiting Assoc. Prof.	Keisuke FUKUI				

Research Center for Statistical Machine Learning

Director Kenji FUKUMIZU　　Vice Director Tomoko MATSUI

Prof.	Kenji FUKUMIZU	Prof.	Tomoko MATSUI	Prof.	Yoshihiko MIYASATO
Prof.	Satoshi ITO	Prof.	Shiro IKEDA	Prof.	Satoshi KURIKI
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	Project Assoc. Prof.	Shinichiro GOTO	Assist. Prof.	Daisuke MURAKAMI
Project Assist. Prof.	Sho SAITO	Project Assist. Prof.	Yoichi MOTOTAKE	Visiting Prof.	Arthur GRETTON
Visiting Prof.	Masataka GOTO	Visiting Prof.	Yuji SHINANO	Visiting Prof.	Takashi TSUCHIYA
Visiting Prof.	Katsuki FUJISAWA	Visiting Assoc. Prof.	Sayaka SHIOTA	Visiting Assoc. Prof.	Tsutomu TAKEUCHI
Visiting Assoc. Prof.	Makoto YAMADA	Visiting Assoc. Prof.	Eiji MOTOHASHI	Visiting Assoc. Prof.	Masaaki IMAIZUMI
Visiting Assoc. Prof.	Kei KOBAYASHI				

Data Science Center for Creative Design and Manufacturing

Director Ryo YOSHIDA　　Vice Director Hironori FUJISAWA

Prof.	Ryo YOSHIDA	Prof.	Hironori FUJISAWA	Prof.	Kenji FUKUMIZU
Prof.	Hideitsu HINO	Assoc. Prof.	Shinya NAKANO	Assoc. Prof.	Daichi MOCHIHASHI
Assoc. Prof.	Stephen WU	Project Assist. Prof.	Liu CHANG	Project Assist. Prof.	Yoshihiro HAYASHI
Project Assist. Prof.	Yuta AOKI	Visiting Assoc. Prof.	Terumasa TOKUNAGA		

Research Center for Medical and Health Data Science

Director Shigeyuki MATSUI　　Vice Director Ikuko FUNATOGAWA

Prof.	Satoshi YAMASHITA	Prof.	Shigeyuki MATSUI	Project Prof.	Shinto EGUCHI
Assoc. Prof.	Hisashi NOMA	Assoc. Prof.	Ikuko FUNATOGAWA	Assoc. Prof.	Masayuki HENMI
Assoc. Prof.	Fumikazu MIWAKEICHI	Project Assoc. Prof.	Kengo NAGASHIMA	Project Assoc. Prof.	Mayumi OKA
Visiting Prof.	Yasuo OHASHI	Visiting Prof.	Senichiro KIKUCHI	Visiting Prof.	Ken KIYONO
Visiting Prof.	Atsushi GOTO	Visiting Prof.	Satoshi TERAMUKAI	Visiting Prof.	Hisateru TACHIMORI
Visiting Prof.	Michiko WATANABE	Visiting Prof.	Toshiya SATO	Visiting Prof.	Satoshi HATTORI
Visiting Prof.	Nobuaki NISHIYAMA	Visiting Prof.	Yoichi ITO	Visiting Assoc. Prof.	Kunihiko TAKAHASHI

Staff

Research Center for Medical and Health Data Science

Visiting Assoc. Prof.	Ryoichi KIMURA	Visiting Assoc. Prof.	Yasunori SATO	Visiting Assoc. Prof.	Masataka TAGURI
Visiting Assoc. Prof.	Kazushi MARUO				

School of Statistical Thinking

Director Yoshinori KAWASAKI　Vice Director Yukito IBA

Prof.	Yoshinori KAWASAKI	Prof.	Satoshi ITO	Prof.	Yukito IBA
Prof.	Kenji FUKUMIZU	Prof.	Yoshiyuki NINOMIYA	Prof.	Hideitsu HINO
Prof.	Shiro IKEDA	Project Prof.	Yoshiyasu TAMURA	Project Prof.	Junji NAKANO
Project Prof.	Manabu IWASAKI	Assoc. Prof.	Kenichiro SHIMATANI	Assoc. Prof.	Masayuki HENMI
Assist. Prof.	Shunichi NOMURA	Project Assist. Prof.	Kazuhei KIKUCHI	Visiting Assoc. Prof.	Osamu KOMORI
Visiting Assoc. Prof.	Kei TAKAHASHI				

Center for Engineering and Technical Support

Director Genta UENO　Vice Director Kazuhiro MINAMI
Deputy Manager Yuriko WATANABE

Unit Leader of Computing Facilities Unit	Mitsuru HAYASAKA	Unit Leader of Computer Networking Unit	Kazuhiro NAKAMURA
Unit Leader of Information Resources Unit	Yuriko WATANABE	Unit Leader of Media Development Unit	Akiko NAGASHIMA

Library

Head Genta UENO

Administration Planning and Coordination Section

Chief Director Hiroe TSUBAKI

Director of Planning Unit	Satoshi ITO	Director of Evaluation Unit	Yoshihiko MIYASATO
Director of Information and Public Relations Unit	Satoshi ITO	Director of Intellectual Property Unit	Satoshi YAMASHITA
Director of NOE Promotion Unit	Satoshi YAMASHITA	Director of Gender Equality Unit	Satoshi ITO
Director of International Affairs Unit	Tomoko MATSUI		

URA Station

	Kozo KITAMURA		Motoi OKAMOTO
	Keisuke HONDA		

Tachikawa Administration Department

Director Isao OSHIRO

General Affairs Division

Manager Mitsuo HAMADA　Deputy Manager Hisayuki IGARASHI
Deputy Manager Yasunori SAITO

Head, General Affairs Team	Ayako NARITA	Head, Personnel Team	Akiharu MIYAGI
Head, Labor Management Team	Yasunori SAITO	Head, Graduate School Team	

Staff

Tachikawa Administration Department

Financial Division

Manager	Katsuhiro OZAKI	Deputy Manager	
Head, General Affairs and Audit Team	Michihito SAKURAI	Head, Budget and Account Settlement Team (NIPR)	Yumiko OKAWA
Head, Budget and Account Settlement Team (ISM)	Hiroaki ARAI	Head, Assets Management and Acceptance Team	Akiko MAEKAWA

Accounting Division

Manager	Koji SAKAMOTO	Deputy Manager	Masayuki KOBAYASHI
Specialist	Hiroshi TAKAGI	Head, Accounting Team	Ichiro KAWAJI
Head, Contract Team1	Takeshi KUWAHARA	Head, Contract Team2	Toshiaki TAKASAKI
Head, Facilities Team	Takuya SAITO		

Research Promotion Division

Manager	Kumiko TANSHO	Deputy Manager	Motokazu TOYODA
Head, Research Promotion Team	Hideaki ASANO	Head, Cooperative Research Team	Hitoshi HIRAYAMA

Council of The Institute of Statistical Mathematics (As of April 1, 2020)

Keiko TAKAHASHI	Counselor for Management, Japan Agency for Marine-Earth Science and Technology (JAMSTEC)/ Director, Yokohama Institute for Earth Sciences (YES)
Hiroshi MARUYAMA	PFN Fellow, Preferred Networks, Inc.
Iguchi SATORU	Professor, Vice-Director General (on Program), National Astronomical Observatory of Japan, National Institutes of Natural Sciences
Fumiyasu KOMAKI	Professor, Graduate School of Information Science and Technology, The University of Tokyo
Masayuki UCHIDA	Professor, Graduate School of Engineering Science, Osaka University
Hiroshi SAIGO	Professor, Faculty of Political Science and Economics, Waseda University
Yasuhiro OMORI	Professor, Faculty of Economics, University of Tokyo
Kikuo MAEKAWA	Professor, Spoken Language Division, Director, Center for Corpus Development National Institute for Japanese Language and Linguistics
Hideki ASOH	Director, National Institute of Advanced Industrial Science and Technology Department of Information Technology and Human Factors Artificial Intelligence Research Center Deputy
Mihoko MINAMI	Professor, Department of Mathematics, Faculty of Science and Technology, Keio University
Satoshi ITO	Professor (Vice Director-General, ISM)
Satoshi YAMASHITA	Professor (Vice Director-General, ISM)
Yoshihiko MIYASATO	Professor (Vice Director-General, ISM)
Tomoko MATSUI	Professor (Director of Department of Statistical Modeling, ISM)
Koji KANEFUJI	Professor (Director of Department of Statistical Data Science, ISM)
Satoshi KURIKI	Professor (Department of Mathematical Analysis and Statistical Inference, ISM)
Genta UENO	Professor (Director of Center for Engineering and Technical Support, ISM)
Yoshinori KAWASAKI	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)

Cooperative Research Committee (As of June 1, 2020)

Hiroyuki MINAMI	Professor, Information Initiative Center, Hokkaido University
Kunihiko TAKAHASHI	Professor, M&D Data Science Center, Tokyo Medical and Dental University
Takahiro TSUCHIYA	Professor, School of Data Science, Yokohama City University
Toshikazu KITANO	Professor, Department of Architecture, Nagoya Institute of Technology
Nagatomo NAKAMURA	Professor, Department of Economics, Sapporo Gakuin University
Atsushi YOSHIMOTO	Professor (Director of Department of Statistical Modeling, ISM)
Koji KANEFUJI	Professor (Department of Data Science, ISM)
Shiro IKEDA	Professor (Department of Mathematical Analysis and Statistical Inference, ISM)
Junji NAKANO	Project Professor (School of Statistical Thinking, ISM)

Managing Committee of School of Statistical Thinking (As of April 1, 2020)

Manabu IWASAKI	Dean/Professor, School of Data Science, Yokohama City University
Toshiyasu MATUSHIMA	Director, Center for Data Science, Waseda University
Hiroshi YAMADA	Professor, Graduate School of Social Sciences, Hiroshima University
Seiji YAMADA	Professor, Digital Content and Media Sciences Research Division, National Institute of Informatics
Junichi SHIOZAKI	Senior Manager, Insight Signal Business Department, Nomura Research Institute, Ltd.
Yoshinori KAWASAKI	Director (School of Statistical Thinking, ISM)
Yukito IBA	Vice Director (School of Statistical Thinking, ISM)
Satoshi ITO	Professor (Vice Director-General, ISM)
Kenichiro SHIMATANI	Associate Professor (Department of Data Science, ISM)

Research Ethics Review Committee (As of April 1, 2020)

Specialist on epidemiology and social research	Masayuki KANAI	Professor, School of Human Sciences, Senshu University
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
Person in citizen's position	Yutaka KURIKI	Kindergarten Director, Nishikokubunji Nursery School
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)
Research education staff of ISM	Koji KANEFUJI	Professor (Department of Data Science, ISM)
Research education staff of ISM	Ikuko FUNATOGAWA	Associate Professor (Department of Data Science, ISM)
Research education staff of ISM	Hisashi NOMA	Associate Professor (Department of Data Science, ISM)

Professor Emeritus (As of April 1, 2020)

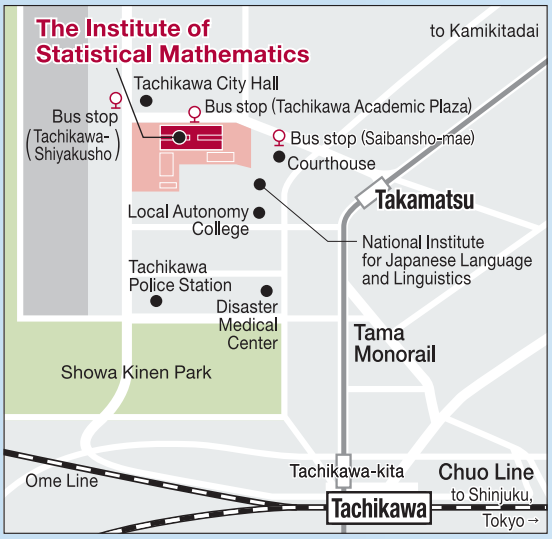
Sigeki NISIHIRA	Tatsuzo SUZUKI	Giitiro SUZUKI	Ryoichi SHIMIZU
Noboru OHSUMI	Masakatsu MURAKAMI	Kunio TANABE	Tadashi MATSUNAWA
Masami HASEGAWA	Yoshiyuki SAKAMOTO	Takemi YANAGIMOTO	Yoshiaki ITOH
Yasumasa BABA	Katsuomi HIRANO	Masaharu TANEMURA	Makio ISHIGURO
Yosihiko OGATA	Hiroe TSUBAKI	Genshiro KITAGAWA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

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.

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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