2021
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2022

Research Organization of Information and Systems

The Institute of Statistical Mathematics

CONTENTS

Message from Director-General

Since its inauguration on June 5, 1944, the Institute of Statistical Mathematics (ISM) has been engaged in research on statistical theory and applications to elucidate and design behavior and other phenomena of interest. This year marks the 77th anniversary of the ISM's establishment. According to the Japanese tradition of celebrating milestone ages, reaching the age of 77 represents a special occasion called "Kiju," or "blessed longevity." We are very grateful for your support, to which the ISM owes its longevity. Our faculty, researchers, and staff will maintain their commitment to ensure that the ISM will continue to address new research challenges as well as professional development in the field of statistics.

In today's world, data are a rich potential resource, similar in that sense to crude oil. Around the world, people are seeking the ideal form of a data-driven society. The advent of a new information technology (IT) society is gradually transforming people's lives. Statistics and data science help generate new knowledge and value from large bodies of data, expanding the boundaries of academic arenas and socioeconomic activities. These situations in Japan and elsewhere call for large numbers of professional statisticians with excellent data processing skills.

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. In addition, the ISM contributes to academic excellence, helps to realize a data-driven society, and trains the next generation of data scientists.

As the 12th Director-General, I am going to follow in their footsteps and guide the ISM to deepen the fundamental mathematics of data science, create and activate research networks, cultivate statisticians, and raise the visibility of their work. The recent achievements of the ISM include 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. Building on these successes, the ISM will launch a project aimed at training statistical experts with advanced knowledge and skills to teach at universities.

The global pandemic of COVID-19 that broke out more than a year ago has not yet been brought under control, partly due to the emergence of new variants. Our battle against COVID-19 has been protracted and unpredictable. The ISM is adopting innovative and flexible measures to continue research activities during the current crisis. It is our sincere hope that the outbreak will subside soon and calm daily life will be restored.

The ISM has a long history of research on mathematical modeling of infectious disease, and has trained many experts in simulations of epidemics and pandemics. To meet the challenges of this difficult time, the ISM leveraged its features as a research institute devoted to statistical and mathematical sciences, and launched a research project in 2020 aimed at preventing the spread of COVID-19. This project seeks to develop statistical and mathematical tools that will play central roles in preventing outbreaks of COVID-19 and similar infectious diseases in the future. The ISM will continue its research and education activities with the goal of applying statistics to challenging social issues, pursuing theoretical research to support their practical applications, and equipping statisticians with the skills to deal with these advanced resources. 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, privacy protection in official statistics, and their applications. By exploring complex phenomena in various fields, the group also aims to contribute to practical applications in academia and policy-making through social surveys.

Metric Science Group

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

Structure Exploration Group

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

Department of Statistical Inference and Mathematics

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

Mathematical Statistics Group

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

Learning and Inference Group

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

Mathematical Optimization Group

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

NOE-type Research

Risk Analysis Research Center

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.

Mathematical Analysis for Random Phenomena

■ The stochastic process as a mathematical expression of a real phenomenon

A real random phenomenon is expressed as a stochastic process mathematically. The Brownian motion is well-known as a movement of pollen floating in the water. Let $B(t)$ $(t \geqq 0)$ be the Brownian motion as a stochastic process. In this case, a random variable $B(t)$ is normally distributed for each $t>0$ and its path is a continuous function of t. But, risk analysis deals with more complicated phenomena.

For example, in a financial crisis or a disastrous earthquake, huge change occurred suddenly and this is a distinctive feature of phenomena involving risk. In such cases, continuous processes are insufficient and stochastic processes with jumps are demanded.

The risk analysis research center cosponsors two symposiums. Both symposiums aim to be a fusion of mathematical theory and statistical application as follows.

■ Infinitely divisible processes and related topics

The symposium started as a workshop of probability theory, but it has developed into a symposium including statistical application. "Infinite divisibility" is the property of a distribution that could be decomposed into identically distribution for an arbitrary number. For example, the normal distribution is expressed as the convolution of same n distributions for arbitrary natural number n.

Various distributions including the Poisson distribution and the stable distribution have this property. The stochastic process version is infinitely divisible process. This research field has been developing as a traditional probability theory. Nowadays, it also becomes an essential tool to construct statistical model for mathematical finance.

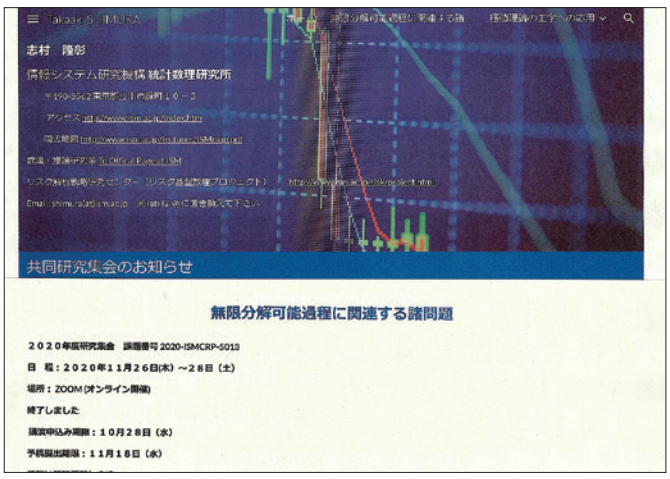
■ Extreme value theory and applications

Extreme value theory deals with extreme events, like biggest one among various data. A typical application of the extreme value theory is disaster prevention because a disaster is caused by extreme event, not usual one.

For example, a flood is caused by heavy rain in a short period, not by total precipitation in the long term. Hence the prediction for heavy rain is essential to defend serious damage and used for design of dikes or evacuation information etc. Not only in a flood but also in various disasters, a few events dominate most of the total damage. Therefore, it is not exaggeration, though extreme value theory is the theory for risk management.

The information on these symposiums is announced on the ISM and my Web site.

Takaaki Shimura



The author's webpage announces the information of the cooperative symposiums.

The cooperative research reports and related books.

A New Adjustment Method Using Spurious Correlations for Multiple Testing

■ Multiple testing and its adjustment method

To understand risk factors for a certain disease, we will consider statistically comparing the features in the group with the disease and the group without the disease. For simplicity, we assume that there are only two types of features for a while. Usually, a statistical test is used for such a comparison, and if it is rejected, the two groups are considered to be different. Since there are two types of features, there are also two tests, which are called multiple testing. In most tests, a significance level of 5% is used, but if we set the significance level of both tests to 5%, the probability of mistakenly rejecting the results may become 10% even though there is no difference between the two groups. Therefore, the significance level of each test is reduced so that the probability of rejection is kept at 5%. This is called adjustment for multiple testing. The simplest method is the Bonferroni method, where the significance level of each test is set to 2.5%. However, this method has the problem that the significance level of each test is so small that even if there is a difference between the two groups, it is not easily rejected. If there is a positive correlation between the features, that is, if there is a positive correlation between the two tests, we can use this information to give an adjustment method that is easier to reject than the Bonferroni method. This is called the MaxT method, and it becomes more effective as the value of the positive correlation increases. Since the value of this correlation is usually not known, it is given by estimation.

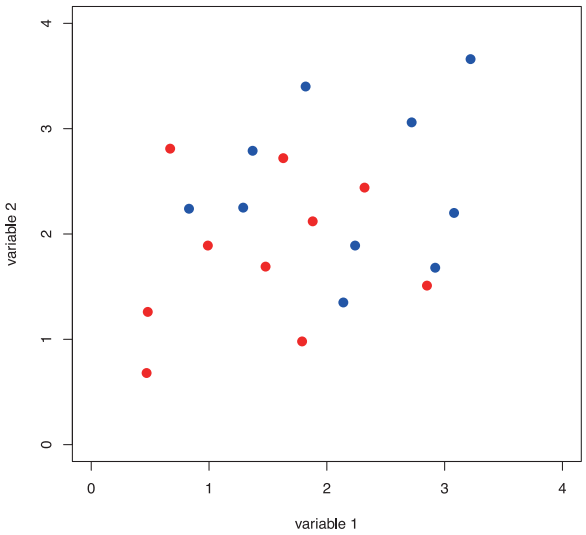


Figure 1: Synthetic data with 2 groups, 2 features and 10 samples.

■ Proposal of a new adjustment method

When estimating the correlation, mixing two groups together leads to an unreasonable value. Figure 1 shows the scatter plots for the two groups, red and blue, with the two types of features represented on the vertical and horizontal axes. The true correlation between the features is 0.15, but both features have a larger expectation for the blue group than for the red group, and so when mixed together, the estimated correlation becomes 0.30. This is called spurious correlation. This is an unjustified value, but it can be used to adjust for the multiple testing, which is the strange finding of this study. When both features influence the disease, the spurious correlation tends to be larger, making it more effective than the MaxT method. In fact, for the data in Figure 1, the MaxT method does not reject both features, while the proposed method using the spurious correlation rejects both features. According to numerical experiments, the effectiveness of the proposed method tends to become more pronounced as the number of features increases. Figure 2 compares the features of purebred mice and its consomic mice, where each cell corresponds to each test. Dark blue, blue, light red, and red indicate the tests rejected by the Bonferroni, MaxT, an improved MaxT, and the proposed methods. Although this data was not compatible with the proposed method, it still rejected 9 new tests.

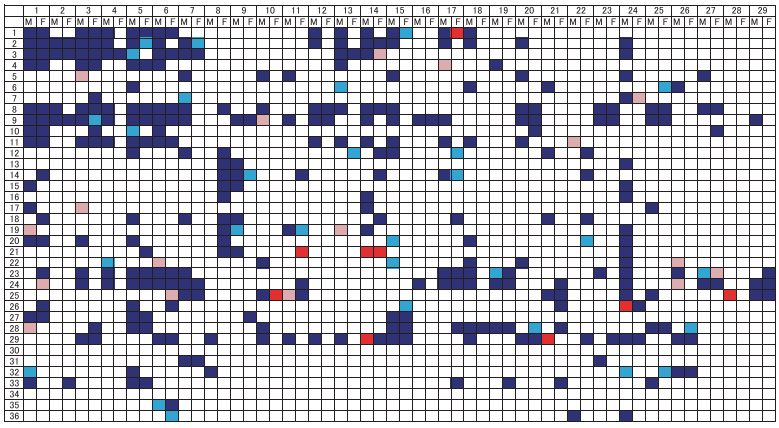


Figure 2: Results of multiple testing for mice data (Ninomiya et al. 2021 JSPI 128-138 Fig. 2).

Yoshiyuki Ninomiya

Geometry of Random Fields —Integral Geometry for Statistical Findings

■ Geometry of random fields

Figure 1 (left) depicts an example of image data (random field). Integral geometry provides a tool to summarize such data. By choosing a threshold, we convert the image into binary data (Figure 2 right).

In the binary image data, there are 5 connected black areas (including two tiny ones) and two holes surrounded by black region. The difference $\chi=5-3=2$ is called the Euler number. The triplet, the Euler number as well as its area and boundary length, is called the Minkowski functional and is used for data analysis.

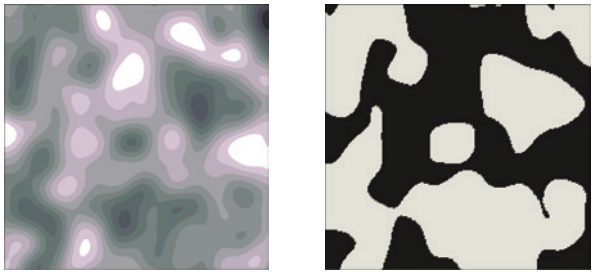


Figure 1: Random field (left) and its excursion set (right).

■ Analysis of CMB data

In Figure 2, for two random fields, the Euler numbers are drawn in blue by changing the threshold v. The orange curves are expected Euler number calculated theoretically by assuming the "Gaussian assumption". One may find that in the left panel two curves are close to each other, but are not in the right panel. Actually, in the left panel the random field was generated by Gaussian random variables, and was not in the right panel.

In this way, the structure of the random field can be investigated by the Euler number. The cosmic microwave background in Figure 3 is microwave observed in all directions of the sky, representing the temperature fluctuation of the universe. The study of this random field is expected to reveal the mechanism of the primitive universe, and the methods of the Euler number and the Minkowski functionls are one of the standard tools. As joint work with researchers in KEK and Kavli IPMU, we are examining the relationship with the random field structure and the Euler number and the Minkowski functionls.

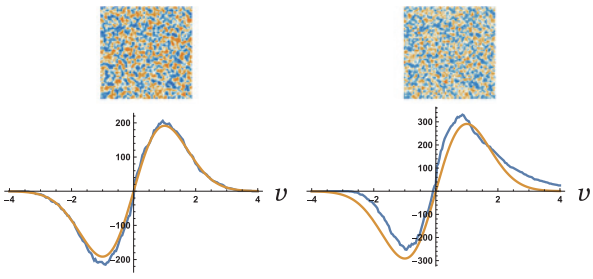


Figure 2: Gaussian random field (left) and non-Gaussian random field (right).

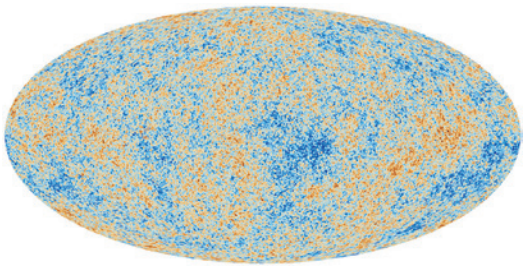


Figure 3: Cosmic Microwave Background (CMB) (Copyright PLANCK).

■ Change point problems

The finding of the Higgs boson, the last elemental particle, was announced on 14th March 2013. Figure 4 is the experimental data published at CERN homepage. Two curves in red in the figure have small peaks. These are indeed evidences of the finding, whereas the rational judgment criterion is needed to distinguish true peaks and stochastic fluctuations (i.e., false positive). This problem is called change point problem or multiple comparisons in statistics, or LEE (look-elsewhere effect) in physics. The theory of geometry of random fields can be utilized in this problem. Genome scan and peak detection in brain image data are similar problems. We are developing the methodology of general purpose as well as related mathematics.

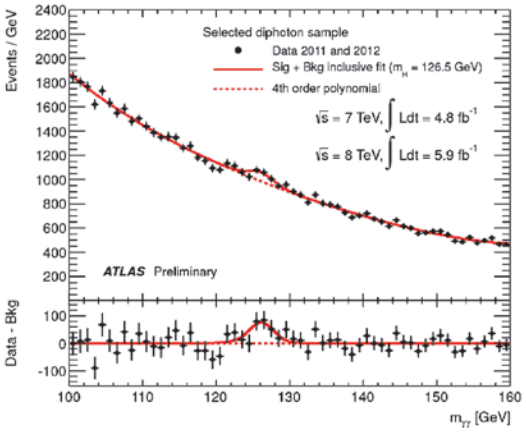


Figure 4: Finding of Higgs boson (Copyright CERN).

Satoshi Kuriki

Interpretation of Trained Deep Neural Networks to Collaborate with Scientists

■ The importance of interpretability in scientific data analysis

In thermodynamics, Gibbs extended the theory of heat engines to chemical reaction theory. It brought great development to science. In this way, human scientific insight obtains general principles beyond mere interpolation. However, it is sometimes difficult to apply this insight to complex systems, such as nonlinear or nonequilibrium phenomena. Recently, there has been a lot of research on analyzing and modeling complex scientific data using machine learning models with high-expression ability, such as deep neural networks (DNNs). However, most of them are interpolative models and consist of nonlinear functions with a large number of parameters, making their interpretation extremely difficult. To overcome this deadlock, we are developing methods to bridge machine learning and human intelligence (Fig. 1). In this paper, we introduce a method for extracting interpretable physical information from a DNN trained with physics data [Y. Mototake, Phys. Rev. E, 2021].

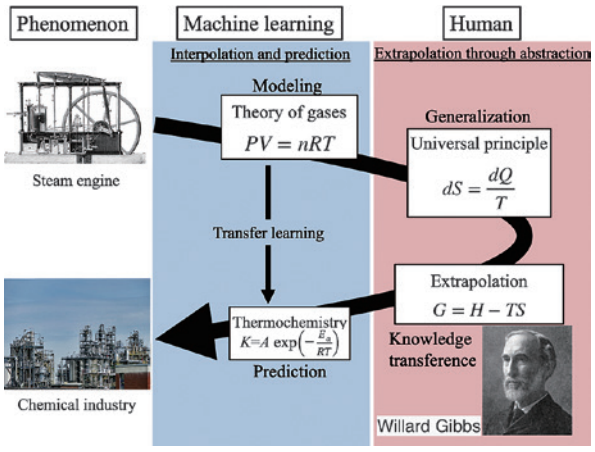


Figure 1: Collaboration between machine learning and humans.

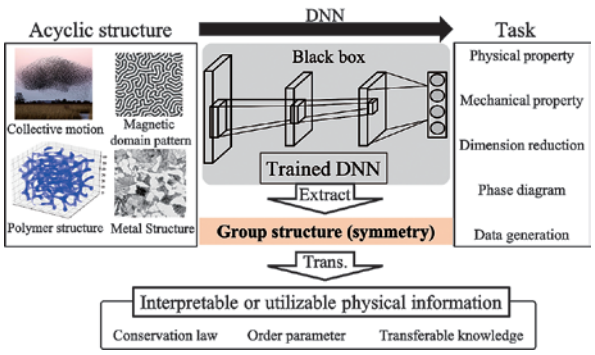


Figure 2: Extraction of interpretable and usable information from trained DNNs.

■ Symmetry of data manifolds and conservation laws

It has been reported that DNNs have the ability to extract data distributions as a subspace, like a low-dimensional manifold, to obtain useful information. In physical systems, the low-dimensional data structure is also related to physical constraints, such as conservation laws or order parameters. In other words, it is expected that we can extract interpretable physics information, such as conservation laws or order parameters, from the data manifold modeled by the DNNs. In Hamiltonian systems, Noether's theorem links the invariance of the system and conservation laws. We theoretically confirmed that the symmetry of a dynamical system can be inferred from the data manifold of physics time-series data and developed a method to extract conservation laws from a trained DNN (Fig. 2).

■ Extraction of conservation laws from trained DNNs

A trained DNN modeling a data manifold could map the input space into a lower-dimensional manifold (Fig. 3). Therefore, in the middle layer of the DNN, the input space of the outer region of the manifold disappears. Based on this picture, we can identify whether a region in the input space is on or off the manifold. Using this identification method, we proposed a method to extract symmetric coordinate transformations of the data manifold. It was confirmed that the proposed method could infer a conservation law for circular motion or the collective behavior of living things. In the future, we plan to advance the method to realize new physical discoveries or efficient learning methods.

Yoh-ichi Mototake

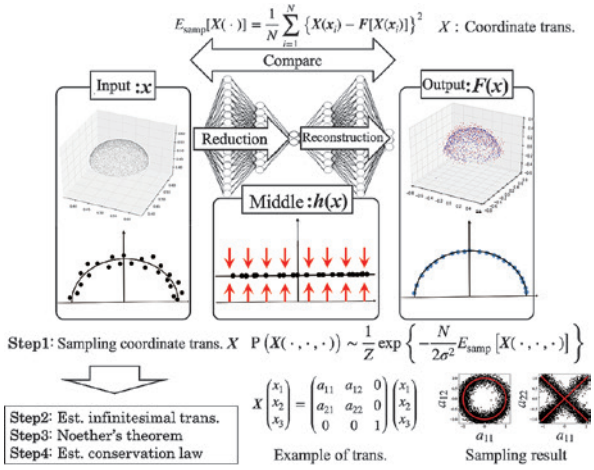


Figure 3: Symmetry extraction and conservation estimation from trained DNNs using the proposed method.

Search for New Quasicrystals Using Machine Learning

■ Accelerating the discovery of new quasicrystals based on data science

Quasicrystals form a class of materials that do not have the translational symmetry of ordinary periodic crystals, but have a high degree of order in their atomic arrangement. The first quasicrystal was discovered by Schechtman in 1984. Over the next 35 years, more than 100 types of quasicrystals were found, and quasicrystals were placed as the third class of solids along with ordinary crystals and amorphous. However, the pace of the discovery has slowed significantly in recent years. We are participating in the Grant-in-Aid for Scientific Research on Innovative Areas, "Hypermaterials: Innovation of Materials Science in Hyperspace"), which started in 2019 (Prof. Ryuji Tamura, Tokyo University of Science). We will accelerate the discovery of new quasicrystals by introducing machine learning techniques to the field.

■ Prediction of chemical compositions to form quasicrystals

We tackled the problem of predicting quasicrystals using a simple workflow of supervised learning. The input variable of the model is the chemical composition. The output variables represent class labels indicating "quasicrystals", "approximant crystals", and "others" including ordinary periodic crystals. As training data, we used the chemical compositions of quasicrystals, approximants, and ordinary crystals that have been discovered so far. We evaluated the predictability of machine learning models for the three-class classification task. The predicted quasicrystalline phases were compared with known experimental phase diagrams, and the precision and recall of the phase prediction reached 0.793 and 0.714, respectively. We aim to use this model to narrow down the candidate compositions that form quasicrystals and approximants.

■ Rules for quasicrystal formation discovered by machine learning

Furthermore, by extracting the input-output rules inherent in the black-box model of machine learning, we have uncovered hidden laws on the formation of quasicrystalline phases. These rules are expressed in five equations for the van der Waals radius of consistent elements and the itinerant valence electron concentration. These conditions provide design guidelines for the search for new quasicrystals. This may open the door to a better understanding of the stability of quasicrystals, a central issue in condensed matter physics.

■ Towards discovery of innovative quasicrystals

With this work, we have taken the first step toward realizing quasicrystal discovery through data science. We are now using our model in the synthetization of new quasicrystals. During nearly 35 years after the discovery of the first quasicrystal, little is known about the formation mechanism of quasicrystals. Data science may make a significant contribution to solving this unsolved issue in quasicrystal research.

Ryo Yoshida

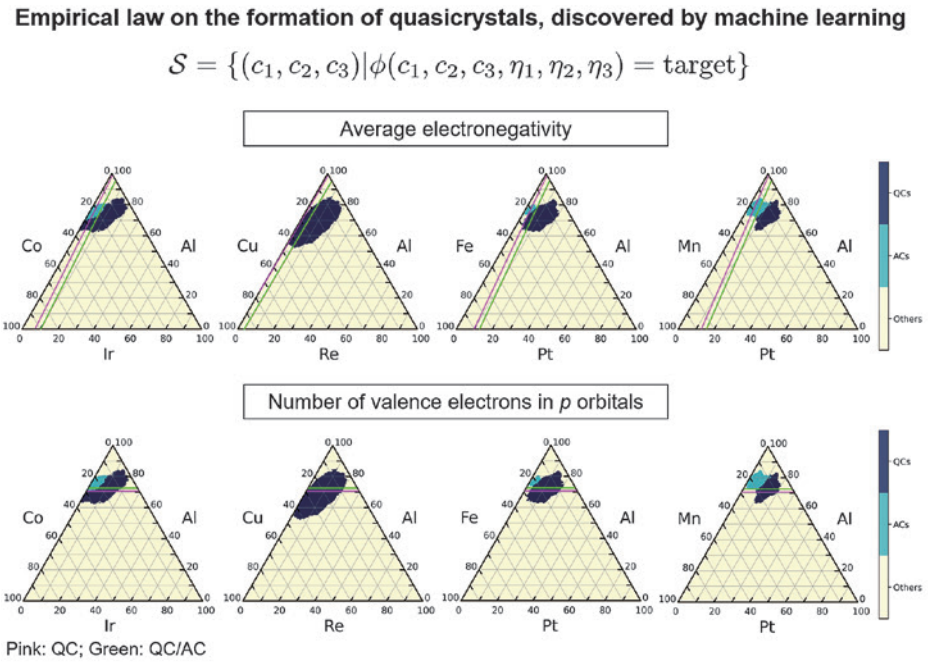


Figure:
Formation rules on quasicrystalline phases that were discovered by machine learning.

Creation of Polymer Properties Database Using Automated Molecular Dynamics Simulation

■ Understanding and discovery of thermally conductive polymers

Organic polymers are materials with huge molecular weight, and have unique characteristics of lightness, ease of processing, and flexibility. The thermal conductivity of polymers is much lower than that of metals and ceramics. In recent years, the application of polymers to electronic devices, such as 5G wireless device, has required to improve heat dissipation. Thus, much attention has been paid to the study of high thermal conductive polymers. Our group is participating in JST-CREST Nano-enabled Thermal Management.

■ Machine learning technologies for automated molecular design

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

■ Lack of open data for data-driven research

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

■ Creation of polymer property database with automated molecular dynamics simulation

We developed a high-throughput calculation system for automated molecular dynamics simulation of polymer properties. We are creating a polymer properties database using this automatic system. Our ultimate goal is to build a database that covers various properties for more than 100,000 polymers. We will observe the joint distribution of multiple properties in the vast material space. We aim to comprehensively identify polymer structures around the Pareto boundaries between multiple properties. Furthermore, novel polymers that can overcome the Pareto boundary may be discovered. We will accomplish this mission as a joint research project under industry-academia partnerships.

Yoshihiro Hayashi

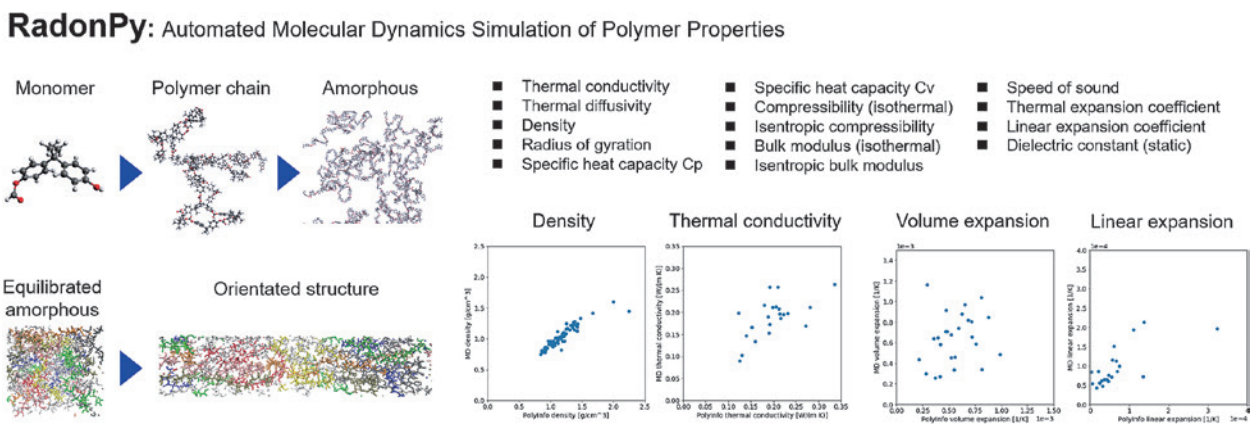


Figure: Automated calculation of polymer properties using molecular dynamics simulation.

Pursuing the Advancement of Medical and Health Data Science

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

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

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

■ Educational and research activities

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

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

e-learning website

Symposium

■ Medical and Health Data Science Research Network

All of the above projects are linked with the activities of the newly launched "Medical and Health Data Science Research Network." This unique network comprises 94 organizations (as of February 2021), including related academic societies, universities, and research institutions in all parts of Japan, as well as hospitals and companies. The substantial advancement of medical and health data science depends on the organic collaboration of researchers in the fields of statistical mathematics and information science and those in the fields of medical and health science. The Center intends to make every possible effort to play an important part in bridging these fields.

Shigeyuki Matsui

Data Science Technology for Advanced Medical Researches

■ Data science technology required for medical science and healthcare practices

In modern society, there have been serious problems concerning human health and medicine, e.g., global pandemic of emerging infectious diseases such as COVID-19 and arrivals of aging societies throughout the world. To develop effective treatments and diagnostic methods, and to conduct policy making based on scientific evidence, adequate data analysis methods are required. Thus, advanced technologies of data science are essential and strongly needed for sustainable medical and healthcare services. We have an international collaborative network with advanced research universities and institutes, and we are proceeding a lot of advanced researches to create scientific evidence that contributes to the real world medical and society problems.

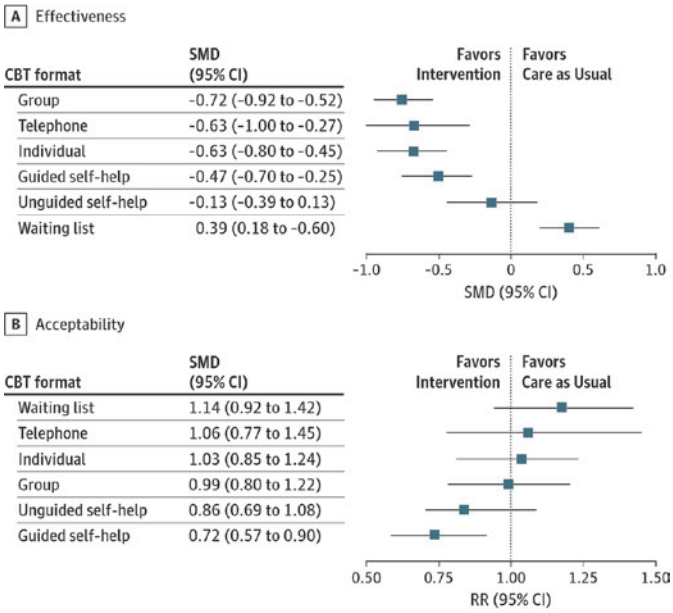


Figure 1: Network meta-analysis for delivery methods of cognitive behavior treatments for major depression. Estimates and 95% confidence intervals for standardized mean differences are presented; the reference treatment is care-as-usual (Cuijpers, Noma et al., JAMA Psychiatry 2019, 76: 700–707).

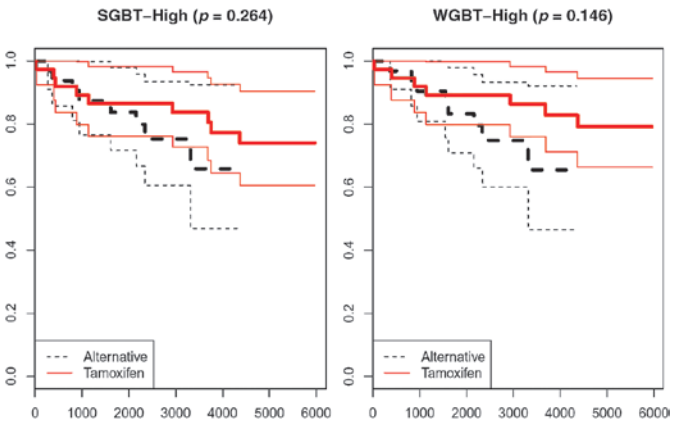


Figure 2: Survival curves for subgroups expected the tamoxifen treatment is effective that were estimated by new machine learning methods using gradient boosting tree (Sugasawa and Noma, Stat Med 2020, 38: 5146–5159).

■ Advanced research synthesis methods for large scale clinical trials databases

Network meta-analysis is a novel data science method for synthesizing past available evidence of published clinical trials and evaluating the comparative effectiveness of available treatments. In Figure 1, we present results of a network meta-analysis that evaluated delivery methods of cognitive behavior treatment (CBT) for major depression (individual/group counselling, internet CBT program, etc). This study synthesized a large clinical trial database based on more than 150 trials using advanced data analysis technology. This study was conducted as an international collaborative work with Vrije Universiteit Amsterdam, Oxford University and Kyoto University, and was graded as ISI Top Paper and Highly Cited Paper. We have also conducted a lot of collaborative works using these methods based on the international collaborative network.

■ Developments of AI and machine learning methods for medical technologies

Recently, AI and machine learning methods have been well studied for developing advanced medical technologies. In Figure 2, we present results of data analyses for personalized breast cancer treatments using tamoxifen by newly developed statistical methods using the gradient boosting tree. Using the new methods, we could identify subgroups that were expected that tamoxifen is more effective than the others. We also conduct clinical epidemiology studies using recent AI technologies such as deep learning actively, e.g., we conducted a health technology assessment study for the effectiveness of diabetes medications using deep neural network as a collaborative study with the University of Tokyo.

Hisashi Noma

Statistical Analysis of Ensemble Data

■ Ensemble data as output of particle filtering

The particle filter (PF) is one of the data assimilation methods. An advantage of PF is that we can deal with nonlinear models and non-Gaussian noise. With PF, we should be able to accurately represent probability distribution of state variables. Now, a question we have is how to handle ensemble data, which is the output of PF. If the ensemble represents a complex distribution accurately, we should extract more information from the ensemble, rather than conventional sample statistics, such as the ensemble mean and the ensemble variance (ensemble spread). Let us consider how to analyze the ensemble if the ensemble may represent a "non-Gaussian" distribution.

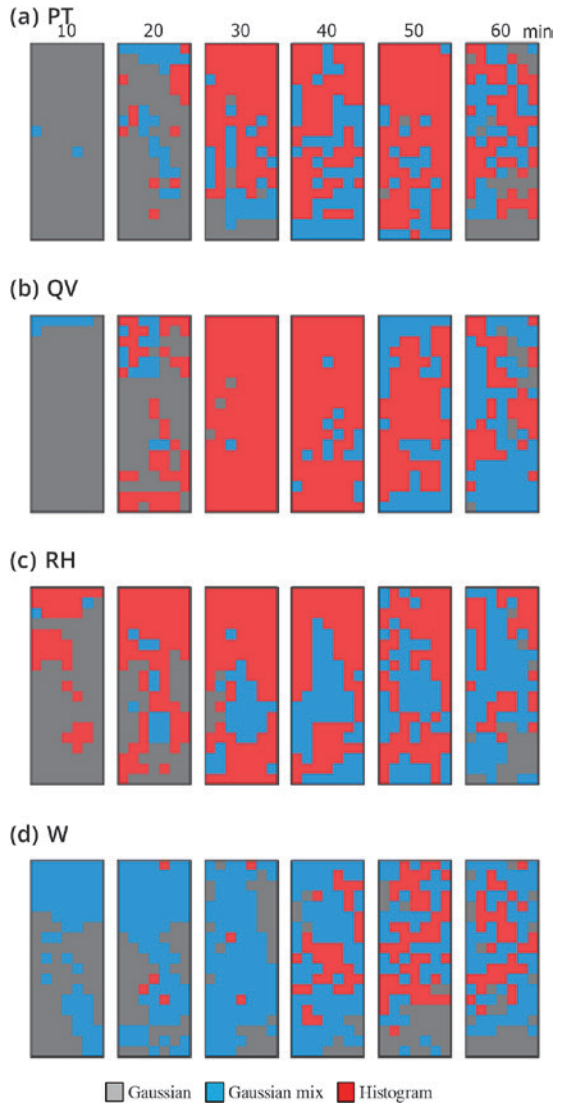


Figure: Temporal variations of probability distribution of various physical quantities observed during development of cumulonimbus: temperature (PT), water vapor (QV), humidity (RH), and vertical wind (W) estimated by a numerical weather prediction model by JMA and the particle filter (PF).

■ Higher-order moments

To insist that the ensemble represents non-Gaussian distribution, let us consider using sample moments of the ensemble. If the ensemble represents a Gaussian distribution, the third-order sample moment should be zero. Then, if the third-order moment is not zero, it means that the ensemble does not represent Gaussian. However, there are concerns as follows. Since we compute moments of a finite number of samples, even if the ensemble is a set of samples from a Gaussian distribution, it is unlikely that the third-order moment will be exactly zero. Conversely, and miraculously, even if the third-order moment becomes zero, can we really conclude that it is zero? If you have another sample, the third-order moment should be non-zero. Then, let us relax the condition that it becomes exactly zero. Rather, let us consider saying that the ensemble represents a Gaussian distribution if the third-order moment is small, while that the ensemble represents non-Gaussian if the third-order moment is large. However, even if we adopt such a condition, how should we distinguish between large and small? Also, let us suppose the ensemble represents a bimodal distribution. The third-order moment will be zero, but we do not like to consider the ensemble to be equivalent to a Gaussian distribution. Apparently, it is not a good idea to analyze ensemble data based on the third-order moment.

■ Claim of non-Gaussian distribution

In the first place, I think it is worthless to claim that "the ensemble represents a non-Gaussian distribution." This is because there are many non-Gaussian distributions. We cannot move forward unless we specify an alternative distribution that is non-Gaussian.

■ Model selection of ensemble data

Here, we consider a Gaussian distribution, a Gaussian mixture distribution, and a histogram; the latter two distributions are alternative distribution models. We select most preferable distribution using information criteria. The figure on the left shows an example of an analysis of ensemble data obtained by applying PF to a numerical weather prediction model of the Japan Meteorological Agency (JMA). It was found that a non-Gaussian shape was first seen in the probability distribution of the upward vertical wind (W), followed by a change in the shape of the probability distribution of water vapor (QV) and temperature (PT).

Genta Ueno

Comparative Analyses with International Survey Data

■ International survey and current issues

One of important research themes of international survey is comparative analyses of national characters. It contributes to development of society by clarifying the differences in national character brought about by differences in political systems, levels of economic development, and cultural factors such as race, ethnicity, and religion, and also by finding universal characteristics that are not affected by differences in these social factors.

On the international survey, face-to-face survey methods have been used for collecting data correctively but the survey methods have been diversified and the budget required has been decreased by spread of the internet, SNS, and crowdsourcing. However, the change has also strengthened the concept of privacy protection and legal problems in academic research have been increased: collecting data online, transferring data across borders, data sharing, and so on.

■ Variables for living happily

It is an important task to find variables to live happily to every nation and society. It has long been argued from post-war data that income is positively correlated with a person's happiness. In 21st century, social capital is considered as one of the important elements for the happiness. In brief, the social capital means richness of good human relationships (family, friend, and community) and data of qualifying them as a person's capital.

7 East Asian countries' survey data showed that many people in the Southeast Asia felt happy and, in contrary, people in the Northeast Asia were not so happy (Fig 1). The result clearly indicates people in developing countries are happier than people in developed ones and only economic wealth does not necessarily decide people's happiness (Fig 2). The data also showed that satisfaction with family was strongly positively corelated to the happiness (Table 1) and Japan, Korea, and Taiwan had low happiness scores and low satisfaction with families (Fig 3).

The data analyses indicate that it is difficult for people to live happily in a society with few human relationships and it can be argued that the government and companies have to construct the welfare systems which can increase people's human relationships.

Our researches aim to contribute to the formation of a better society by examining the values of people in various societies.

Kiyohisa Shibai

	How happy currently
Satisfaction with Family finances (income, expenses)	.629
Employment and job stability	.518
Job	.594
Family life	.716
Married life	.639
Relationships with friends and acquaintances	.595

Table 1: Correlation matrix between happiness score and satisfactions.

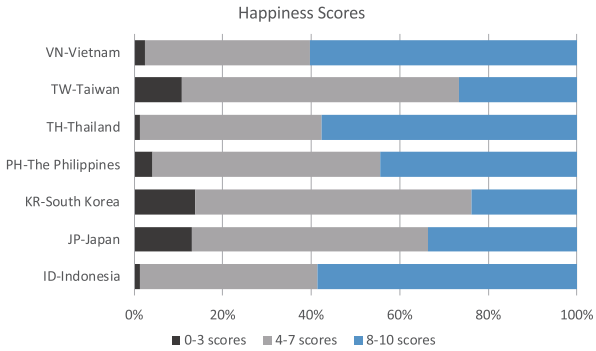


Figure 1: Ratio of happiness score.

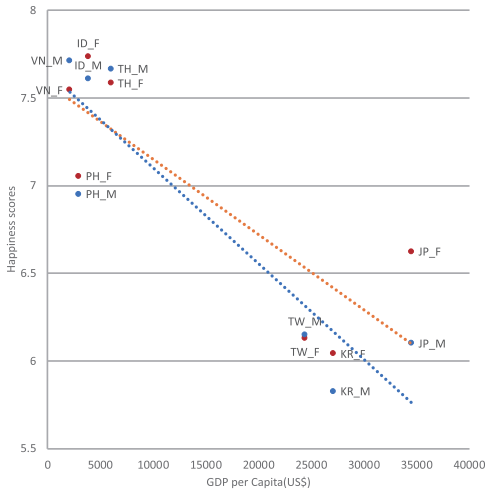


Figure 2: Dot plot of gdp per capita and happiness score.

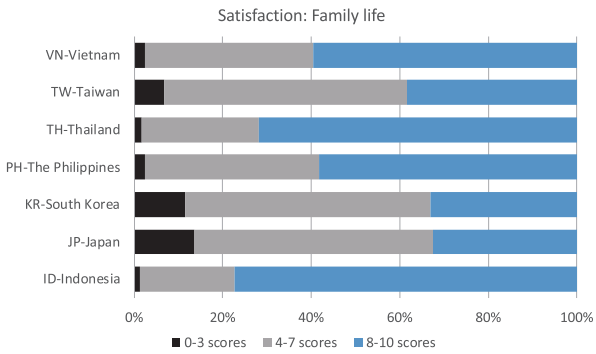


Figure 3: Ratio of satisfaction with family.

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. Almost 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 for 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

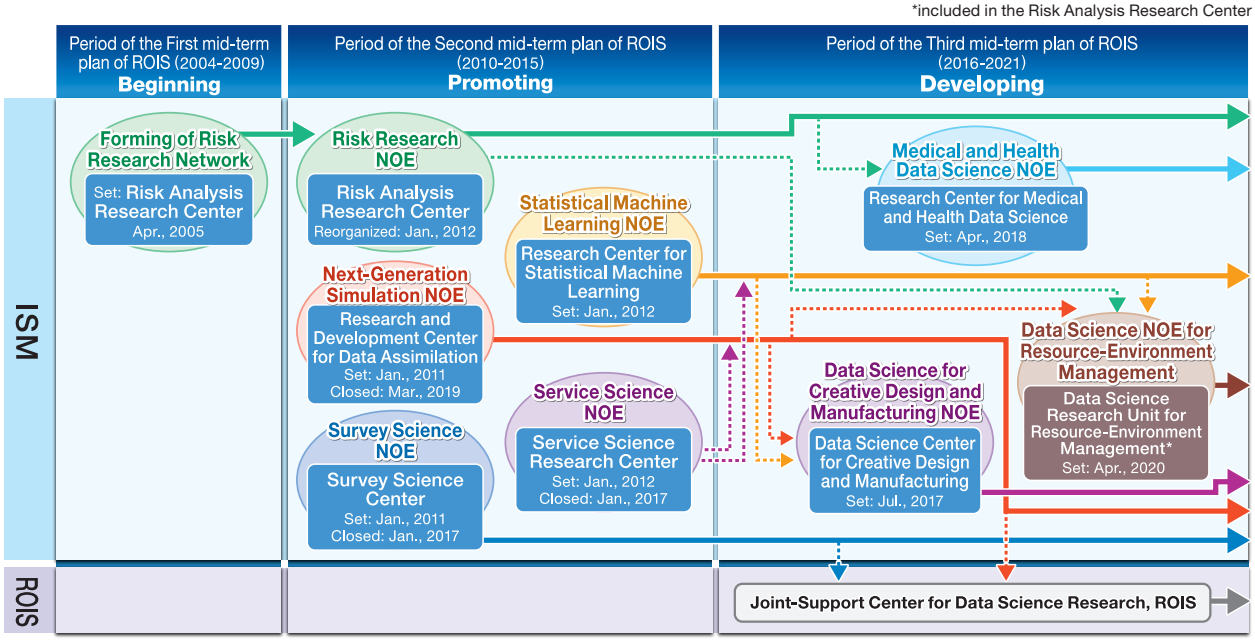


Fig. 1: Brief history of NOE (Network Of Excellence) Project (dotted lines mean history or transformation in each NOE)

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 and 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. ISM also set up the new NOE domain and its research unit, Data Science for Resource-Environment Management in April 2020. 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: Data Science"), 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/

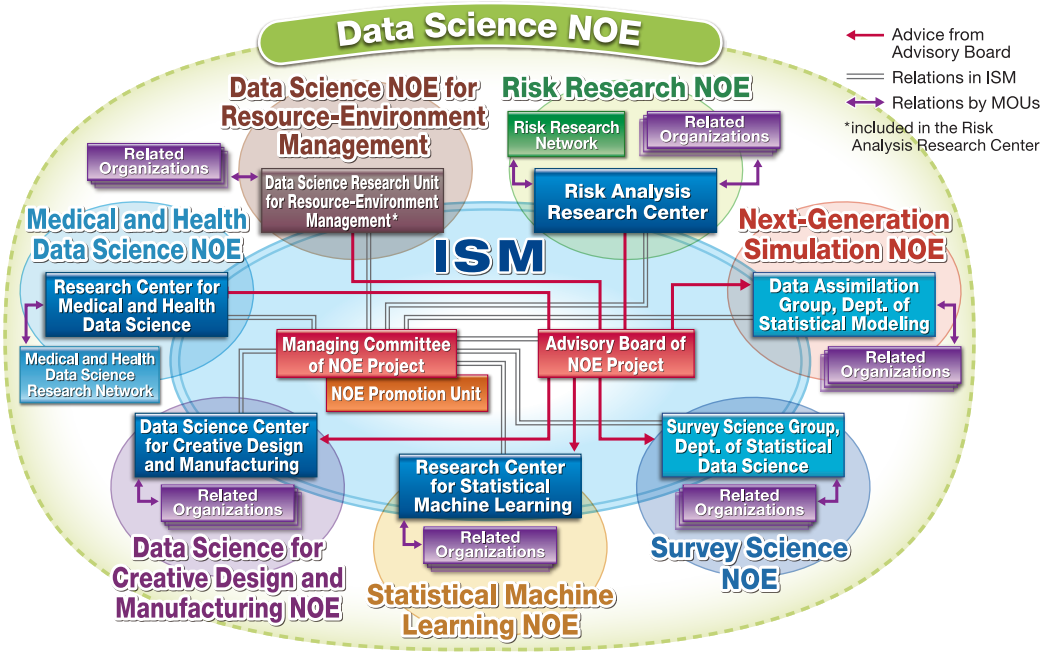


Fig. 2: Relationship diagram of the NOE (Network Of Excellence) Project.

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. In FY 2020, we launched online courses. The following are the principal projects.

Research Collaboration Startup

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

Open-type Professional Development Program

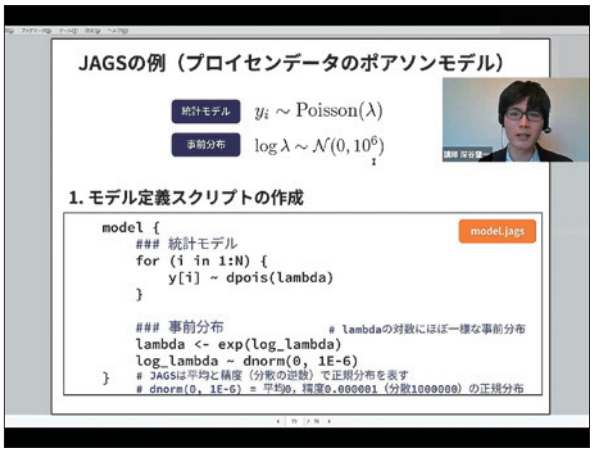
This is a spin-out program from ISM cooperative research projects. Establishing a goal is an indispensable element of the proposal of a cooperative research project. On the other hand, such goal setting is irrelevant for a summer school program, study session, or retreat. Since the launch of the School 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 2020, seven workshops have been accepted after review.

Statistical Mathematics Seminar Series

The Institute holds weekly seminar series on statistical mathematics every Wednesday. The seminars are led by in-house and external lecturers to showcase their latest studies. These lectures are currently held online due to COVID-19. To view the seminar schedule and learn more about the program, please visit the Institute of Statistical Mathematics website.
https://www.ism.ac.jp/index_e.html

Leading DAT

In FY 2017, the School of Statistical Thinking launched a program called “Leading DAT” aimed at training data scientists with the knowledge and skills in statistical mathematics required by modern society. In FY 2020, we held two Leading DAT lectures online, entitled "L-S. Decision Trees and Ensemble Learning: From Basics to Practice" and “L-B1. An Introduction to Statistical Modeling”. Around one third of the attendants of L-B1 enroll the Leading DAT Training Course (half course), in which we grant certificates to participants who have fulfilled the course requirements, including attendance in L-B1 lecture and submission of reports. A total of 20 people have been granted the certificate of completion.



Online lecture (L-B2)

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 2020, 4 lectures and one course (including Leading DAT) were held and the number of participants was 321. The total numbers of lectures and courses held from 1969 to March, 2021 were 386 and 4 respectively, with a total of 28,220 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
Department of Actuarial Studies and Business Analytics, Macquarie University	Australia (Sydney)	December 21, 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	2015	2016	2017	2018	2019	2020
Number of Activities	183	187	161	166	178	145

■ 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

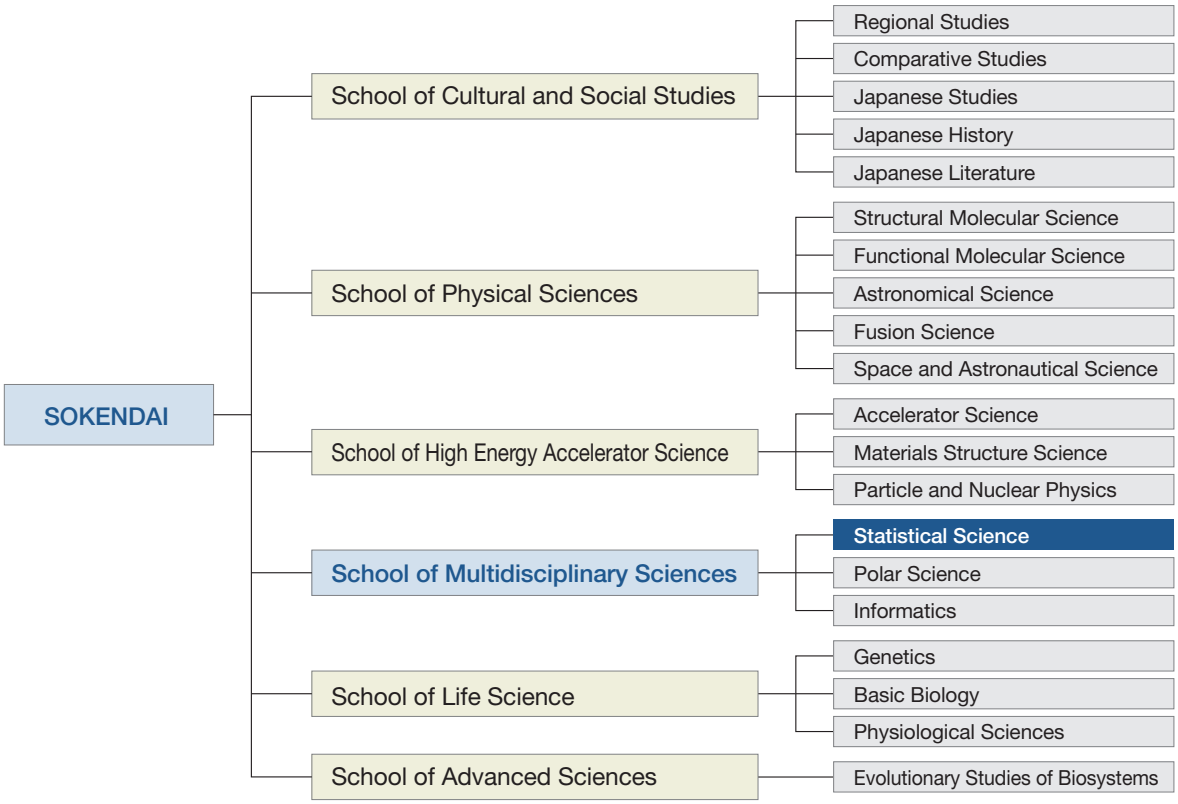
Major Research Fields

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

Features of Education and Research

- 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, 2021)

■ 5-year doctoral course:Quota,2

Year of enrollment	2016	2017	2018	2019	2021
Number of students	1	1	1	2	1

■ 3-year doctoral course:Quota,3

Year of enrollment	2016	2017	2018	2019	2020	2021
Number of students	4 ③	3 ③	7 ⑤	15 ⑫	3 ①	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 (23) • 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 (4) • Oita University (1) • The University of Electro-Communications (1)

University Background of Students

Private universities

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

Foreign universities

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

Degrees Awarded

Year	2014	2015	2016	2017	2018	2019	2020
Doctor of Philosophy	5	5	7	5	5	5	4

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. • Taisho Pharmaceutical Holdings

Facilities and Equipment

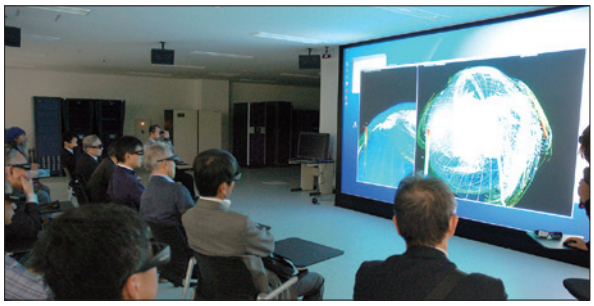
Computational Resources (As of April 1, 2021)

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

In 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)



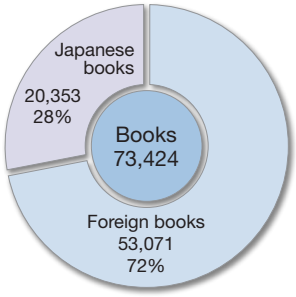
200-inch wide screen showing 3D movies in 4K resolution

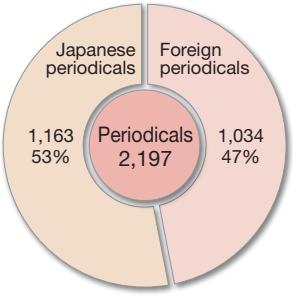
Library and Materials (As of April 1, 2021)

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 (2020)

Type	Personnel expenses	Non-personnel expenses	Total
Expenditure	653,933	864,450	1,518,383

Unit: 1,000JPY

Accepted External Funds (2020)

Type	Joint research	Subcontracted research, Trustee business	Academic Consulting	Contract researchers	Contribution for scholarship	Total
Items	24	22	7	2	3	58
Income	46,450	120,778	5,114	566	5,600	178,508

Unit: 1,000JPY

Grant-in-Aid for Scientific Research "KAKENHI" (2020)

Research Category	Items	Amount Granted
Grant-in-Aid for Scientific Research on Innovation Areas	2	21,710
Grant-in-Aid for Scientific Research (S)	—	—
Grant-in-Aid for Scientific Research (A)	6	46,670
Grant-in-Aid for Scientific Research (B)	8	27,834
Grant-in-Aid for Scientific Research (C)	19	25,090
Grant-in-Aid for Challenging Research (Exploratory)	2	3,640
Grant-in-Aid for Early-Career Scientists	13	16,429
Grant-in-Aid for Research Activity Start-up	—	—
Grant-in-Aid for JSPS Fellows	1	780
Grant-in-Aid for Publication of Scientific Research Results	—	—
Total	51	142,153

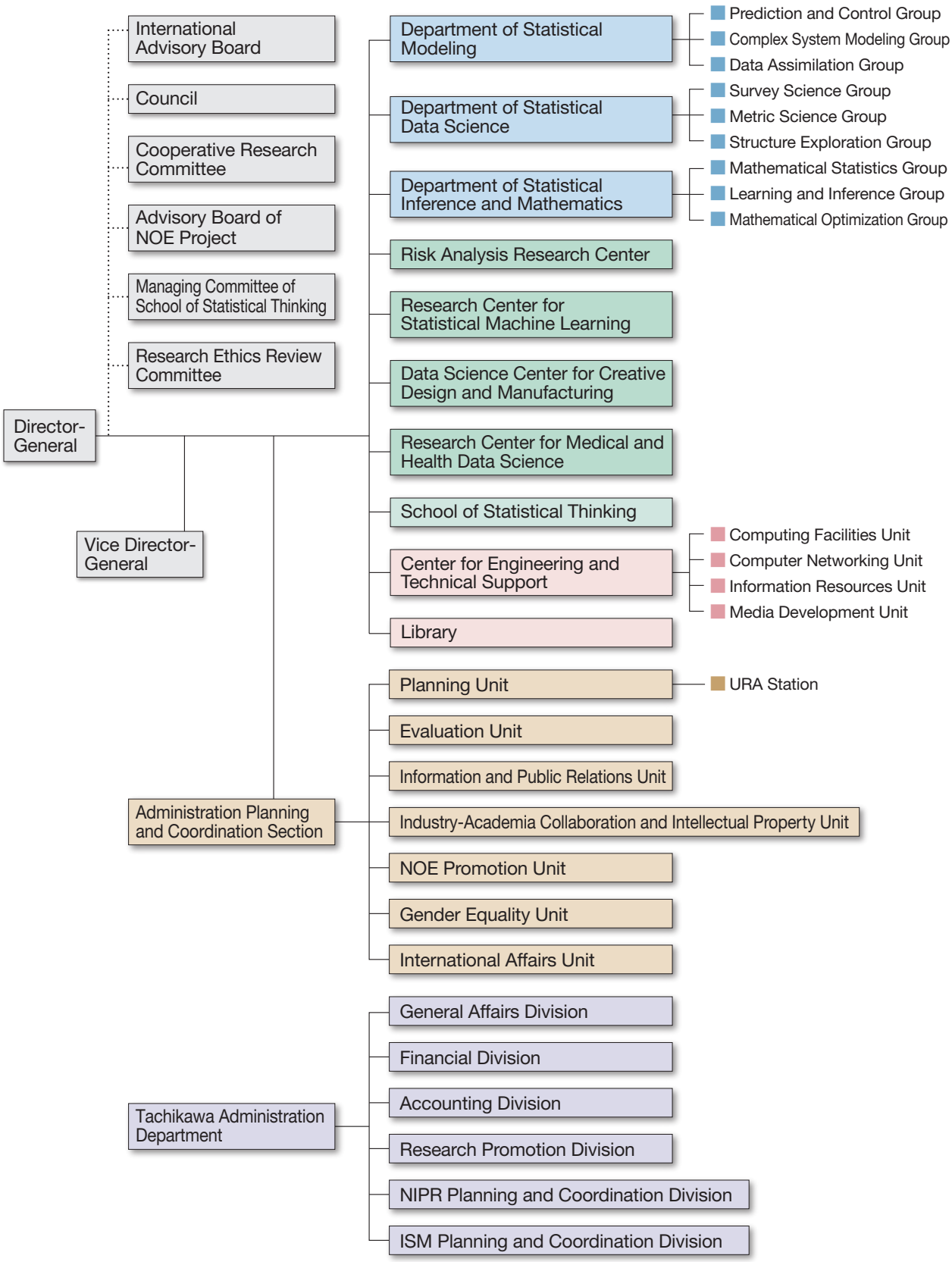
Unit: 1,000JPY

Site and Buildings (As of April 1, 2021)

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

Organization

Organization Diagram (As of April 1, 2021)



Number of Staff (As of April 1, 2021)

Type	Director-General	Professor	Associate Professor	Assistant Professor	Administ-rative Staff	Technical Staff	Total
Director-General	1						1
Department of Statistical Modeling		6	6				12
Department of Statistical Data Science		5	6	2			13
Department of Statistical Inference and Mathematics		7	8				15
School of Statistical Thinking				2			2
Center for Engineering and Technical Support						10	10
Administration Planning and Coordination Section					1		1
Tachikawa Administration Department					(36)	(1)	(37)
Total	1	18	20	4	1(36)	10(1)	54(37)

( ) 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, 2021)

Director-General	Hiroe TSUBAKI				
Vice Director-General	Yoshinori KAWASAKI	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	Assoc. Prof.	Kengo KAMATANI		

Data Assimilation Group

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

Department of Statistical Data Science

Director Koji KANEFUJI

Survey Science Group

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

Staff

Department of Statistical Data Science

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	Project Researcher	Yasuhiro TANAKA		

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 ITO

Mathematical Statistics Group

Prof.	Satoshi KURIKI	Prof.	Yoshiyuki NINOMIYA	Prof.	Shuhei MANO
Assoc. Prof.	Shogo KATO	Assoc. Prof.	Takaaki SHIMURA	Assoc. Prof.	Keisuke YANO
Visiting Prof.	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.	Figueira LOURENÇO BRUNO				

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.	Kengo KAMATANI	Assoc. Prof.	Keisuke YANO	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	Project Assoc. Prof.	Yuuki RIKIMARU	Assist. Prof.	Daisuke MURAKAMI
Project Assis. Prof.	Takaaki KOIKE	Project Assis. Prof.	Xiong ZIYAO	Project Assis. Prof.	Tran DUC VU
Project Assist. Prof.	Hideaki NAGAHATA	Project Researcher	Yosihiko OGATA	Visiting Prof.	Masakazu ANDO
Visiting Prof.	Shinsuke ITO	Visiting Prof.	Masao UEKI	Visiting Prof.	Tadashi ONO
Visiting Prof.	Takashi KAMEYA	Visiting Prof.	Naoto KUNITOMO	Visiting Prof.	Naoki SAKAI
Visiting Prof.	Yo SHEENA	Visiting Prof.	Yasutaka SHIMIZU	Visiting Prof.	Kyomi SHIRAKAWA
Visiting Prof.	Kazuyuki SUZUKI	Visiting Prof.	Rinya TAKAHASHI	Visiting Prof.	Satoshi TAKIZAWA
Visiting Prof.	Hideatsu TSUKAHARA	Visiting Prof.	Hiroshi TSUDA	Visiting Prof.	Tetsuji TONDA
Visiting Prof.	Shunji HASHIMOTO	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.	Sadaaki MIYAMOTO	Visiting Prof.	Hitoshi MOTOYAMA
Visiting Prof.	Hirokazu YANAGIHARA	Visiting Prof.	Yoshiki YAMAGATA	Visiting Prof.	Nakahiro YOSHIDA
Visiting Prof.	Takaaki YOSHINO	Visiting Prof.	Toshinao YOSHIBA	Visiting Prof.	Tetsuya IWASA
Visiting Prof.	Katsutoshi NAGASHIMA	Visiting Prof.	Hiroaki NAGAFUJI	Visiting Assoc. Prof.	Takaki IWATA
Visiting Assoc. Prof.	Bogdan Dumitru ENESCU	Visiting Assoc. Prof.	Yukihiko OKADA	Visiting Assoc. Prof.	Teppei OGIHARA

Risk Analysis Research Center

Visiting Assoc. Prof.	Kenichi KAMO	Visiting Assoc. Prof.	Takafumi KUBOTA	Visiting Assoc. Prof.	Yuta KOIKE
Visiting Assoc. Prof.	Masashi KONOSHIMA	Visiting Assoc. Prof.	Noriyoshi SAKUMA	Visiting Assoc. Prof.	Seisho SATO
Visiting Assoc. Prof.	Junichi TAKAHASHI	Visiting Assoc. Prof.	Isao TAKABE	Visiting Assoc. Prof.	Dou XIAOLING
Visiting Assoc. Prof.	Kazuyoshi NANJO	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.	Yukito IBA
Prof.	Yoshihiko MIYASATO	Prof.	Satoshi ITO	Prof.	Shiro IKEDA
Prof.	Satoshi KURIKI	Prof.	Shuhei MANO	Prof.	Hironori FUJISAWA
Prof.	Kazuhiro MINAMI	Prof.	Hideitsu HINO	Assoc. Prof.	Daichi MOCHIHASHI
Assoc. Prof.	Shinsuke KOYAMA	Assoc. Prof.	Ayaka SAKATA	Assoc. Prof.	Mirai TANAKA
Assist. Prof.	Daisuke MURAKAMI	Project Assist. Prof.	Sho SAITO	Project Assist. Prof.	Yoichi MOTOTAKE
Project Assist. Prof.	Toshimitsu ARITAKE	Project Assist. Prof.	Kotaro SAKAMOTO	Project Assist. Prof.	Hideto NAKAJIMA
Project Researcher	Zheng NING	Visiting. Prof.	Arthur GRETTON	Visiting. Prof.	Masataka GOTO
Visiting. Prof.	Yuji SHINANO	Visiting. Prof.	Takashi TSUCHIYA	Visiting. Prof.	Katsuki FUJISAWA
Visiting Assoc. Prof.	Masaaki IMAIZUMI	Visiting Assoc. Prof.	Shuichi KAWANO	Visiting Assoc. Prof.	Kei KOBAYASHI
Visiting Assoc. Prof.	Sayaka SHIOTA	Visiting Assoc. Prof.	Tsutomu TAKEUCHI	Visiting Assoc. Prof.	Eiji MOTOHASHI
Visiting Assoc. Prof.	Makoto YAMADA				

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.	Stephen WU
Project Assist. Prof.	Liu CHANG	Project Assist. Prof.	Yoshihiro HAYASHI	Project Assist. Prof.	Yuta AOKI
Project Researcher	Aiko TAKAHASHI	Project Researcher	Yoh NOGUCHI	Project Researcher	Hironao YAMADA
Visiting. Prof.	Junichiro SHIOMI	Visiting. Prof.	Junko MORIKAWA	Visiting Assoc. Prof.	Masaaki TAKADA

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.	Mayumi OKA	Visiting. Prof.	Manabu AKAZAWA
Visiting Prof.	Yoichi ITO	Visiting. Prof.	Senichiro KIKUCHI	Visiting. Prof.	Ken KIYONO
Visiting. Prof.	Atsushi GOTO	Visiting Prof.	Toshiya SATO	Visiting Assoc. Prof.	Kunihiko TAKAHASHI
Visiting Assoc. Prof.	Masataka TAGURI	Visiting Prof.	Hisateru TACHIMORI	Visiting Prof.	Satoshi TERAMUKAI
Visiting Prof.	Nobuaki NISHIYAMA	Visiting. Prof.	Satoshi HATTORI	Visiting Prof.	Michiko WATANABE
Visiting Assoc. Prof.	Ryoichi KIMURA	Visiting Assoc. Prof.	Yasunori SATO	Visiting Assoc. Prof.	Kazushi MARUO
Visiting Assoc. Prof.	Shonosuke SUGASAWA	Visiting Assoc. Prof.	Kengo NAGASHIMA	Visiting Assoc. Prof.	Chieko ISHIGURO

School of Statistical Thinking

Director Satoshi KURIKI Vice Director Yukito IBA

Prof.	Yoshinori KAWASAKI	Prof.	Yukito IBA	Prof.	Satoshi KURIKI
Prof.	Hironori FUJISAWA	Prof.	Kazuhiro MINAMI	Prof.	Yoshiyuki NINOMIYA

Staff

School of Statistical Thinking

Prof.	Hideitsu HINO	Prof.	Shiro IKEDA	Project Prof.	Masato CHINO
Project Prof.	Hiroko NAKANISHI	Project Prof.	Kazuo MUROTA	Project Prof.	Manabu IWASAKI
Project Prof.	Kunio TANABE	Project Prof.	Yasunori SAWAMURA	Assoc. Prof.	Kenichiro SHIMATANI
Assoc. Prof.	Masayuki HENMI	Assoc. Prof.	Keisuke YANO	Assist. Prof.	Akifumi OKUNO
Assist. Prof.	Kei NOBA	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	Yoshinori KAWASAKI	Director of Evaluation Unit	Yoshihiko MIYASATO
Director of Information and Public Relations Unit	Yoshihiko MIYASATO	Director of Industry-Academia Collaboration and Intellectual Property Unit	Satoshi YAMASHITA
Director of NOE Promotion Unit	Satoshi YAMASHITA	Director of Gender Equality Unit	Yoshinori KAWASAKI
Director of International Affairs Unit	Hiroe TSUBAKI		

URA Station

Kozo KITAMURA	Motoi OKAMOTO	Keisuke HONDA

Tachikawa Administration Department

Director Hikaru SASAGAWA

General Affairs Division

Manager Mitsuo HAMADA　　Deputy Manager Hisayuki IGARASHI
Deputy Manager

Head, General Affairs Team	Ayako NARITA	Head, Personnel Team	Akiharu MIYAGI
Head, Labor Management Team	Keiko SHIMIZU	Head, Graduate School Team	

Financial Division

Manager Katsuhiro OZAKI　　Deputy Manager Hiroaki ARAI

Head, General Affairs and Audit Team	Hiroaki ARAI	Head, Budget and Account Settlement Team (NIPR)	Takeshi KUWAHARA
Head, Budget and Account Settlement Team (ISM)	Akiko MAEKAWA	Head, Assets Management and Acceptance Team	Taku SASAKI

Accounting Division

Manager Koji SAKAMOTO　　Deputy Manager

Specialist	Hiroshi TAKAGI	Head, Accounting Team	Hitoshi HIRAYAMA
Head, Contract Team (NIPR)	Yumiko OKAWA	Head, Contract Team (ISM)	Toshiaki TAKASAKI
Head, Facilities Team	Takuya SAITO		

Research Promotion Division

Manager Kumiko TANSHO　　Deputy Manager Hiromi OBAMA

Head, Research Promotion Team	Ichiro KAWAJI	Head, Cooperative Research Team	Hiromi OBAMA

Staff

Tachikawa Administration Department

NIPR Planning and Coordination Division

Manager Kumiko TANSHO　　Deputy Manager Motokazu TOYODA

Head, NIPR Planning and Coordination Team

ISM Planning and Coordination Division

Manager Mitsuo HAMADA　　Deputy Manager Hisayuki IGARASHI

Head, ISM Planning and Coordination Team Ayako NARITA

Council of The Institute of Statistical Mathematics (As of April 1, 2021)

Keiko TAKAHASHI	Senior Researcher (Professor), Global Consolidated Research Institute for Science Wisdom, Comprehensive Research Organization, Waseda University
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	Adjunct Researcher, Artificial Intelligence Research Center, Department of Information Technology and Human Factors, National Institute of Advanced Industrial Science and Technology
Mihoko MINAMI	Professor, Department of Mathematics, Faculty of Science and Technology, Keio University
Yoshinori KAWASAKI	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 ITO	Professor (Director of Department of Mathematical Analysis and Statistical Inference, ISM)
Genta UENO	Professor (Director of Center for Engineering and Technical Support, ISM)
Satoshi KURIKI	Professor (Director of School of Statistical Thinking, ISM)
Kenji FUKUMIZU	Professor (Department of Mathematical Analysis and Statistical Inference, ISM)
Hironori FUJISAWA	Professor (Department of Mathematical Analysis and Statistical Inference, ISM)

Cooperative Research Committee (As of June 1, 2021)

Toshikazu KITANO	Professor, Department of Architecture, Civil Engineering and Industrial Management Engineering, Nagoya Institute of Technology
Shido SAI	Professor, Department of Economics, Faculty of Economics, Okayama Shoka University
Takashi SEO	Professor, Department of Applied Mathematics, Faculty of Science Division I, Tokyo University of Science
Nagatomo NAKAMURA	Professor, Faculty of Economics and Business Administration, Sapporo Gakuin University
Hiroki MASUDA	Professor, Department of Mathematical Sciences, Faculty of Mathematics, Kyushu University
Tomoko MATSUI	Professor (Director of Department of Statistical Modeling, ISM)
Kenichiro SHIMATANI	Associate Professor (Department of Statistical Data Science, ISM)
Masayuki HENMI	Associate Professor (Department of Statistical Inference and Mathematics, ISM)
Hiroko NAKANISHI	Project Professor (School of Statistical Thinking, ISM)

Managing Committee of School of Statistical Thinking (As of April 1, 2021)

Ken KUROKAWA	Vice Director/Professor, National Institute of Genetics
Manabu KOBAYASHI	Professor, Center for Data Science, Waseda University
Yoshiyuki TAKEUCHI	Vice Director/Associate Professor, Graduate School of Economics/Center for Mathematical Modeling and Data Science, Osaka University

Managing Committee of School of Statistical Thinking

Yoshihiko NISHINO	Director, Advanced Analytics & AI Innovation Division, SAS Institute Japan, Ltd.
Jinfang WANG	Professor/Dean, School of Data Science, Yokohama City University
Satoshi KURIKI	Director (School of Statistical Thinking, ISM)
Yukito IBA	Vice Director (School of Statistical Thinking, ISM)
Yoshinori KAWASAKI	Professor (Vice Director-General, ISM)
Hiroko NAKANISHI	Project Professor (School of Statistical Thinking, ISM)

Research Ethics Review Committee (As of April 1, 2021)

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)

International Advisory Board (As of April 1, 2021)

Chun-houh CHEN	Director and Research Fellow, Institute of Statistical Science, Academia Sinica
Ying CHEN	Associate Professor, Department of Mathematics, National University of Singapore
Arnaud DOUCET	Statutory Professor and Professor of Statistics, Department of Statistics, University of Oxford
Jaeyong LEE	Professor, Department of Statistics, Seoul National University
Donald RICHARDS	Distinguished Professor of Statistics, Department of Statistics, Pennsylvania State University
Pavel SHEVCHENKO	Professor, Department of Actuarial Studies and Business Analytics, Macquarie Business School,Macquarie University
Alan WELSH	E.J. Hannan Professor of Statistics, College of Business and Economics, The Australian National University

Advisory Board of NOE Project (As of June 1, 2021)

Satoshi ITOH	Chief Coordinator, Foundation for Computational Science
Naonori UEDA	Vice Director, RIKEN Center for Advanced Intelligence Project (AIP)
Yasushi OKADA	President, The Japan Pharmaceutical Manufacturers Association
Masafumi KAMACHI	Project Principal Engineer, Information Engineering Program, Research Institute for Value-Added-Information Generation, Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
Yoshimichi SATO	Department Head and Professor, Faculty of Humanities, Kyoto University of Advanced Science
Ken MATSUSHITA	Director-General, Institute for Monetary and Economic Studies, Bank of Japan
Yoshiki YAMAGATA	Professor, Graduate School of System Design and Management, Keio University

Professor Emeritus (As of April 1, 2021)

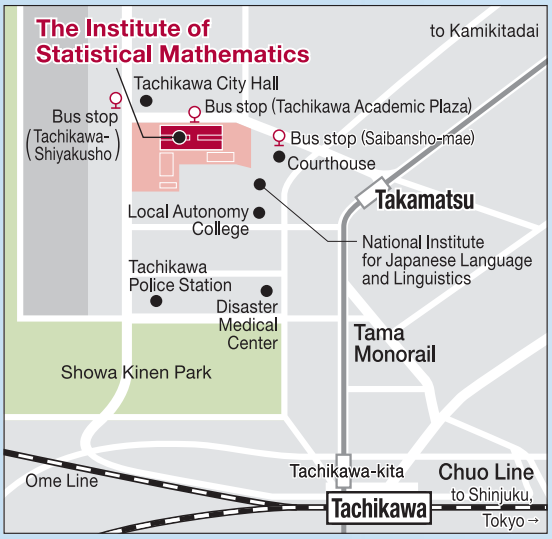
Sigeki NISIHIRA	Tatsuzo SUZUKI	Giitiro SUZUKI	Ryoichi SHIMIZU
Noboru OHSUMI	Masakatsu MURAKAMI	Kunio TANABE	Tadashi MATSUNAWA
Masami HASEGAWA	Yoshiyuki SAKAMOTO	Takemi YANAGIMOTO	Yoshiaki ITOH
Yasumasa BABA	Katsuomi HIRANO	Masaharu TANEMURA	Makio ISHIGURO
Yosihiko OGATA	Hiroe TSUBAKI	Genshiro KITAGAWA	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.
2021	April	ISM Planning and Coordination Division was instituted within Tachikawa Administration Department.

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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