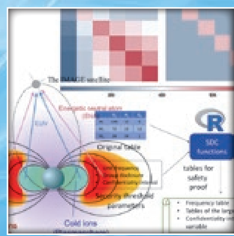
Research Organization of Information and Systems

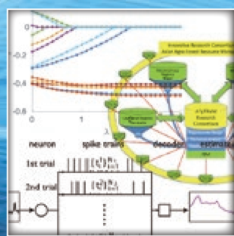
The Institute of Statistical Mathematics

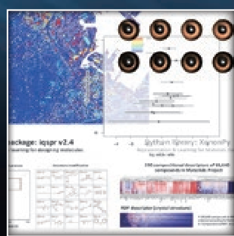
2018-2019

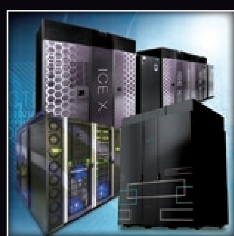
ISM

The Institute of Statistical Mathematics









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Message from Director-General

This is the last fiscal year that I will serve as the Director-General. I took over the post from the former Director-General, Dr. Kitagawa, in April 2011, just after the Great Eastern Japan Earthquake. Immediately after I took office, the “Big Data” era arrived, and the media began to focus on the training of people who can make decisions based on data, a cause for which the Institute has fought alone for a long time at the national level. In addition, due to the AI (Artificial Intelligence) boom for the last two or three years, statistics and mathematical science, which constitute the foundation of AI technology, have been fervently spotlighted. In the present moment, statistical mathematics benefits from the highest degree of understanding by the public over the long history of our institute, which will celebrate its 75th anniversary next year. Under these circumstances, I always felt very responsible during my seven-year term as the Director-General, but at the same time I had the opportunity to perform highly challenging work. Due to the financial situation, which has gotten harsher every year, it was difficult to say whether I could sufficiently meet expectations from people outside the organization. However, thanks to support from the research communities and the sincere cooperation of the staff of the Institute, I believe that I have adequately achieved the goals that I had when I took this post.

While I have only one year remaining in my term, we have embarked on the reform of our two main projects, the NOE (Network Of Excellence) Project and the Project for Fostering and Promoting Statistical Thinking. At the end of the fiscal year before last, we closed two NOE-type research centers, and last July we launched the Data Science Center for Creative Design and Manufacturing. Moreover, this April we set up the new Research Center for Medical and Health Data Science, with the goal of establishing structures for statistical education and research support in the national medical academia and to promote the upgrading of data science research. As I explained above, the NOE projects offer the opportunity to promote new transdisciplinary research projects while responding to current social needs by boldly restructuring the groups of our research centers.

As for the Project for Fostering and Promoting Statistical Thinking, in the last fiscal year we launched the Leading DAT (Data Analysis Talents) program, dedicated to fostering world-class data scientists, by fundamentally revising our long-renowned tutorial courses. Among the Leading DAT program, the Leading DAT Training Course is our unique attempt to conduct intensive training for a small number of people with high potential. The training consists of practical problem-solving exercises and special talks, in addition to the contents of the Leading DAT lectures. Participants who successfully complete the course will be granted a certificate of completion. In the last fiscal year the first group of more than 20 participants finished the course.

At present, in both public and private universities, a wide variety of reforms are underway to allow students to study data science systematically from the undergraduate to the Master’s level. Under these circumstances, the Institute intends to strengthen various programs targeted at postdoctoral fellows and young faculty members, with a focus on recurrent education of working technicians (researchers). We are trying to respond to the critical shortage of data scientists and AI technicians by fostering people who can ensure the implementation of data science education with proper timing.

It is essential for the institute to globalize statistical mathematics. These days, we are placing more emphasis on the enrichment of programs conducted according to the academic exchange agreements than on increasing the number of such agreements. In fact, mutual exchange of postdoctoral fellows and young faculty members, as well as joint research based on such programs, has become very active. In particular, we see the dynamic expansion of exchange with Asian countries, significantly promoted by support from URAs (University Research Administrators). In addition to promoting exchange with foreign institutions, we have made efforts to reinforce the functions of statistical mathematics, which has the effect of linking various fields and people through enhancing the diversity of faculty. To this end, we take pro-active measures such as preferentially employing young people after the retirement of senior faculty members or their departure to outside institutions, as well as actively employing women and foreigners. Consequently, the Institute is now filled with a youthful atmosphere, and we anticipate that this fresh sensibility will lead to exciting research projects. In the one year that is left to me as Director-General, I intend to contribute even more intensively to the Institute, as well as to society at large. I would appreciate your continued support.

Tomoyuki Higuchi
Director-General
The Institute of Statistical Mathematics

Basic Research

Department of Statistical Modeling

The Department of Statistical Modeling works on structural modeling of physical phenomena related to numerous factors, and also 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 software development.

Data Assimilation Group

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

Department of Statistical Data Science

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

Survey Science Group

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

Metric Science Group

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

Structure Exploration Group

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

Department of Statistical Inference and Mathematics

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

Mathematical Statistics Group

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

Learning and Inference Group

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

Mathematical Optimization Group

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

NOE-type Research

Risk Analysis Research Center

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

Research and Development Center for Data Assimilation

Research and Development Center for Data Assimilation aims to construct simulation models that can predict the future and to design effective observation systems by means of “data assimilation”, which is a fundamental technology integrating numerical simulations and observational data.

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 manage extension courses.

- **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 education courses open to the public.
- **Media Development Unit** The Media Development Unit is in charge of publishing and editing of research results and PR brochures.

Statistical Disclosure Control for Tabular Data

On-site service for accessing official microdata

For many years, the Japanese government has been conducting various surveys (e.g., the Population Census) and has recently launched the on-site use service that enables a researcher to access official microdata at a secure on-site facility, as shown in Figure 1.

However, since official microdata might contain sensitive information on participants of the surveys, a researcher can receive only analysis results that satisfy safety requirements examined by an output checker. To pass the output checking process, it is necessary to perform *statistical disclosure control* on analysis results, which partially masks the original information.

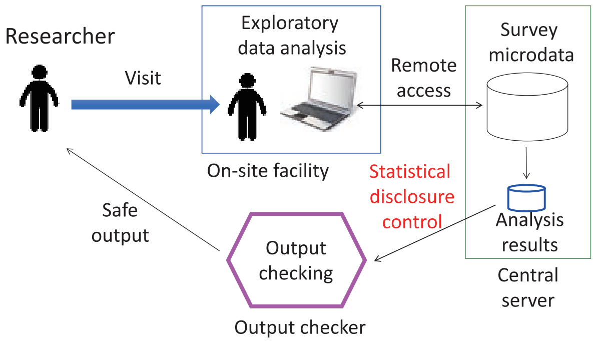


Figure 1: On-site use service in Japan.

Sensitive cells in tabular data

Tabular data is a base for the analysis of official microdata. However, there exist significant risks of revealing sensitive information in microdata through table cells of small unit counts.

Consider a frequency and a magnitude tables of two variables, *Jobs* and *Regions*, in Figure 2. Since there exists only a single unit in cell (M_2, P_3), the corresponding cell of the magnitude table reveals the exact income (i.e., 22) of that unit. Also, even if the cell (M_3, P_5) contains two units, either one of the two units contributing to the cell can obtain the income of the other unit by subtracting his own salary from the sum of the two in the magnitude table.

We, therefore, consider cells of small counts sensitive and suppress those small cell values. However, since it is possible to restore suppressed cell values by considering linear relationships among cell variables in terms of marginal sums, we need to perform additional *secondary* cell suppressions to resolve this issue.

Jobs

Frequency table (Regions × Jobs)

	P_1	P_2	P_3	P_4	P_5	Sum
M_1	20	15	30	20	10	95
M_2	72	20	1	30	10	133
M_3	38	38	15	40	2	133
Sum	130	73	46	90	22	361

Magnitude table on incomes

	P_1	P_2	P_3	P_4	P_5	Sum
M_1	360	450	720	400	360	2290
M_2	1440	540	22	570	320	2892
M_3	722	1178	375	800	363	3438
Sum	2522	2168	1117	1770	1043	8620

Income sums

Figure 2: Disclosure risks in sensitive tabular cells.

Statistical disclosure tool in R

To determine a set of secondary suppressed cells requires solving an optimization problem of minimizing information loss under the constraints of ensuring enough uncertainty on the values of primary suppressed cells. Since it is infeasible to manually perform this task, we have been developing a statistical disclosure control tool in R.

Our tool, which consists of a set of R functions, supports various sensitivity rules, such as (n, k)-rule, $p\%$ rule, for primary suppressions and performs secondary suppressions while producing auxiliary tables that prove the safety of the suppressed table. For future work, we plan to evaluate the usability and performance of our tool with researchers who use the on-site service in Japan.

Kazuhiro Minami

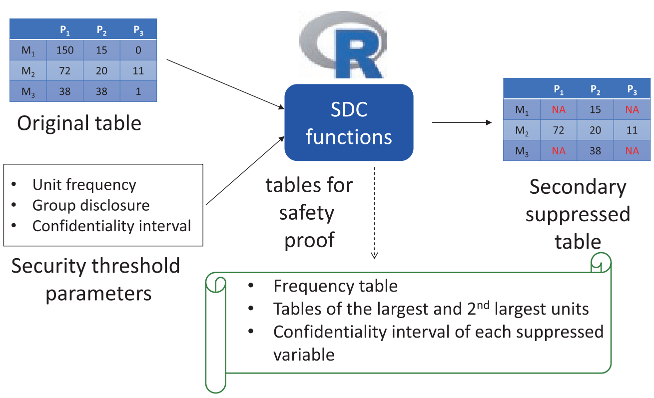


Figure 3: Statistical disclosure control tool for tabular data in R.

Research Consortium for Asian Agro-Forest Resource Management "A^{2}gFReM Research Consortium"

Resource management

Among Asian countries, ecosystems like croplands, forests, lakes and rivers are considered important natural resources because of the various ecosystem services they provide, such as biodiversity and carbon sequestration. They also make significant contributions to the socioeconomic development of these countries through economic production. Therefore, any mismanagement or misuse of these resources can threaten the basis of their livelihood. For example, without appropriate spatial and temporal planning for expansion of palm tree plantation to meet the needs of rising domestic and international demand for palm oil, can lead to degradation of forest ecosystems and increase the risk of deteriorating ecosystem services, which can negatively impact local communities. Also, the mismanagement or misuse of croplands adjacent to rivers and lakes can negatively impact those ecosystems in terms of water quality and aquatic life. If these negative impacts are quantified by the best scientific evidence and latest statistical techniques, we can seek an optimal solution considering the negative impacts. From these results, policies can be framed to mitigate the risk of losing ecosystem services and ensure sustainable economic development that meets the need of local communities.

The objective of this project is to develop a research consortium (called A^{2}gFReM Research Consortium) to conduct a collaborative research on agriculture and forest resource management in Asian countries such as Cambodia, Vietnam, Nepal, Laos and Indonesia (Fig 1). In the resource management, it has been the desire to collect and archive field data, develop a data base, conduct statistical analyses, project the availability of natural resources in the future, and develop a decision support system for managing their natural resource efficiently and effectively using a mathematical programing approach. The system described above eventually help us to conduct policy analyses based on best scientific evidence available and the latest analytical tools. The research consortium also provides an opportunity to conduct collaborative researches, and finally but not the least, contribute to capacity building of young scholars and practitioners in Asian countries through the workshop.

Workshop in Cambodia, 2017

Research collaboration through MOU:

http://formath.jp/workshop/

We have already signed MOUs and MOA with governmental research institutes in Cambodia and Vietnam and national universities in Nepal and Laos. We are currently in the process of signing another MOU with a national university in Indonesia.

Atsushi Yoshimoto

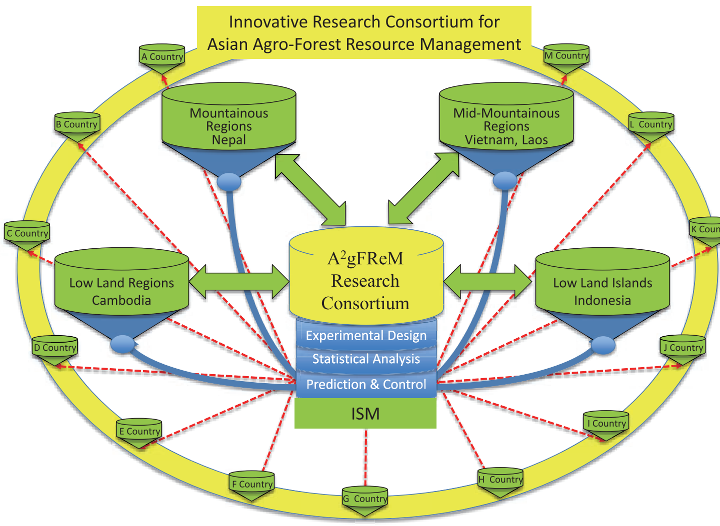


Figure 1: Overview of A^{2}gFReM Research Consortium.

Data Assimilation for Estimating Magnetospheric Environment

The magnetosphere, which is the outer space region from thousands to hundred thousands km in altitude, is important for human activities because a large number of artificial satellites such as navigation satellites and weather satellites are operated as infrastructures. In the magnetosphere, charged particles are widely distributed. Those charged particles may cause various phenomena which affect human activity. For example, spacecraft charging due to high-energy charged particles can destroy electronic devices installed on the spacecraft. Aurora storm due to dynamical process of charged particles in the magnetosphere can interfere with electromagnetic communications which may affect aircraft operations at high latitudes. It is thus demanded to monitor the state of the spatial distribution and temporal variation of charged particles in the magnetosphere.

Although in-situ observations by artificial satellites are widely used for monitoring the state of the magnetosphere, it can not provide the global state of the magnetosphere because each individual satellite provides only the information at its location. However, useful tools for obtaining the global state of the magnetosphere have recently become available. One is imaging observations which remotely obtain global images about the magnetosphere. The information of the low-energy charged particle distribution can be obtained with an extreme ultraviolet (EUV) camera, and the information on the high-energy charged particle distribution can be obtained with the remote observation of energetic neutral atoms (ENA) generated from high-energy ions and low-energy neutral particles. The other useful tool is networks of ground-based observations. Since various physical phenomena would propagate along terrestrial magnetic field lines down to the ionosphere below 1000 km altitude, ground-based observations of the ionosphere can obtain various signals from the magnetosphere.

Assimilation of remote observation data

These remote observations do not provide direct information on meaningful physical variables in the magnetosphere. Our research group therefore aims at enabling us to estimate the global structures and temporal variations of physical variables in the magnetosphere by using the data assimilation approach. We are developing a data assimilation system which incorporates the EUV and ENA data obtained from the IMAGE satellite operated by NASA. The result of the experiment with artificial data sets of EUV and ENA demonstrates how well our data assimilation system works.

Shin'ya Nakano

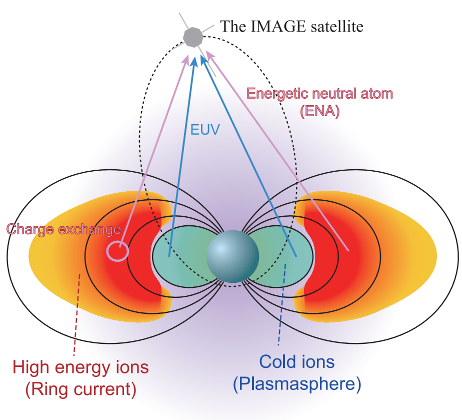


Figure 1: Schematic picture of remote observation from the IMAGE satellite.

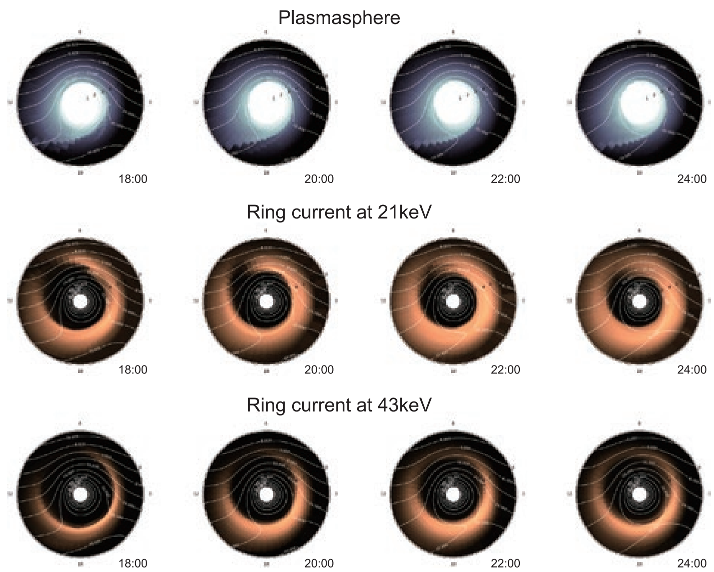


Figure 2: Result of the data assimilation experiment with artificial ENA and EUV data.

Flood Risk Trade-Off Analysis Using High-Resolution Remotely Sensed Imagery

Flood risk and trade-off

Along with the progress of global warming, adaptation and mitigation of cities to climate change attracts a considerable attention. Especially, in Japan, where storm and flood disaster risks are projected to increase, it is an emergent task to build resilience against these risks in bayside cities. On the other hand, bayside areas are also attractive districts in many cases, with scenic ocean view and rich natural environment. It is important to make disaster prevention policies considering the trade-off between disaster risks and positive benefits from the ocean.

High-resolution remote sensing data and urban monitoring

Recent remote sensing (RS) technology enables us monitoring urban environment in a high-resolution manner. For example, Digital Surface Model (DSM; Figure 1, 2) is a digital representation of the 3-dimensional urban space, which was created using observations acquired by LiDAR (Light Detection And Ranging), which is an RS observatory. In this study, the DSM was used to evaluate (a) flood risk and (b) positive benefits from the ocean, including openness of view, goodness of ocean view, distance to the ocean, and greenness of the neighborhood.

Quantification of flood risk trade-offs

This study analyzes the trade-off between (a) flood risk and (b) positive benefits from the ocean by estimating their non-linear impacts on condominium unit prices. Figure 3 shows estimated impacts from (b) open view, ocean view, and (a) flood risk. This figure suggests that open/ocean view have positive impact on residential prices. (Although not shown in the figure,) it is also suggested that bayside neighborhoods with much green areas have greater value than the other districts. These results are intuitively reasonable. By contrast, any statistically significant impacts are not found from flood risk. Based in the result, flood risks might have been underestimated/ignored while positive benefits from the ocean are highly evaluated.

This is a collaborative study with Professor Yoshiki Yamagata, National Institute for Environmental Studies.

Daisuke Murakami

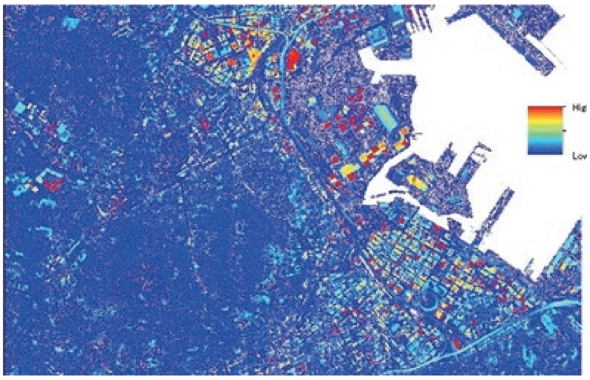


Figure 1: Digital Surface Model (DSM; Center of Yokohama).

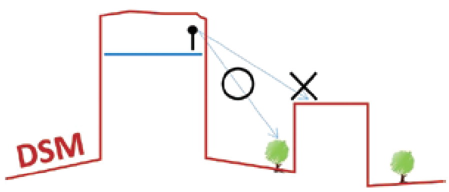


Figure 2: DSM and image of the 3D view evaluation.

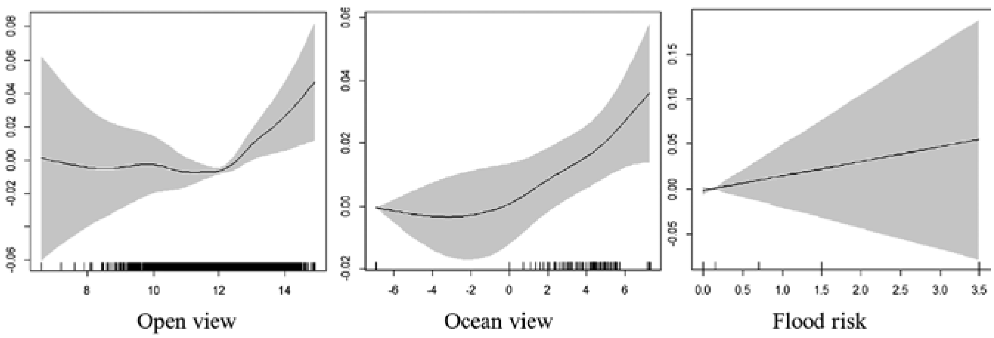


Figure 3: Estimated non-linear influence (x-axis: value of explanatory variables, y-axis: estimated influence).

Time Series Data Mining Based on Event Analysis

Statistical analysis of event cascades

Our project concerns modeling and inference of event cascades, which ensue when events cause other events to occur, triggering further events. Example events in this context include chemical reactions, posting and sharing content on social networking services, etc. Because event cascades are universal in a wide variety of systems, its comprehension is essential for understanding the emergence of complex phenomena.

Mutually exciting point processes (i.e., Hawkes processes) are widely used for modeling and analyzing event sequences. The rate of event occurrences in these models is partitioned into two components: a background rate, which describes exogenous effect (e.g., trends); and a mutually exciting component, in which events trigger an increase in the process rate. Owing to the latter component, Hawkes processes exhibit rich dynamical behavior, in terms of event cascades. Much attention has recently been paid to the field of social data mining. Modeling and inference of social networks, built upon Hawkes processes, form active research areas.

Whereas Hawkes processes describe series of events in continuous time, events in real data are often aggregated within consecutive periods (e.g., day or week), resulting in sequences of event count data in discrete time units. Hawkes processes can be applied to analyze such data; however, it is more desirable to use a statistical model that directly accounts for count data.

We proposed a statistical model for count sequence networks that possesses a cascade structure. Based on the proposed model, we develop an efficient statistical method to estimate the event cascades and the model parameters. we applied our method to chain-reaction bankruptcy event data (Figure 1).

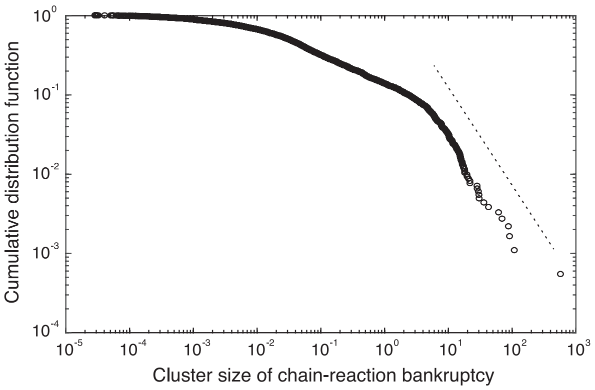


Figure 1: Cumulative distribution function of cluster size of chain-reaction bankruptcy.

Statistical analysis of neural data

Perception, memory, learning and decision making are processes carried out in the brain.

The performance of such intelligent tasks is made possible by the communication of neurons (the cells of which the brain consists) through sequences of voltage pulses called "spikes."

I am interested in formulating methods of extracting information from the neuronal activity exhibited while the brain carries out high-level processes (Figure 2). In particular, we formulated a power-law exhibited in the fluctuation of neuronal firing, based on which we constructed a statistical model of spike trains. We are developing a Bayesian decoding algorithm that extract information from neural data.

Shinsuke Koyama

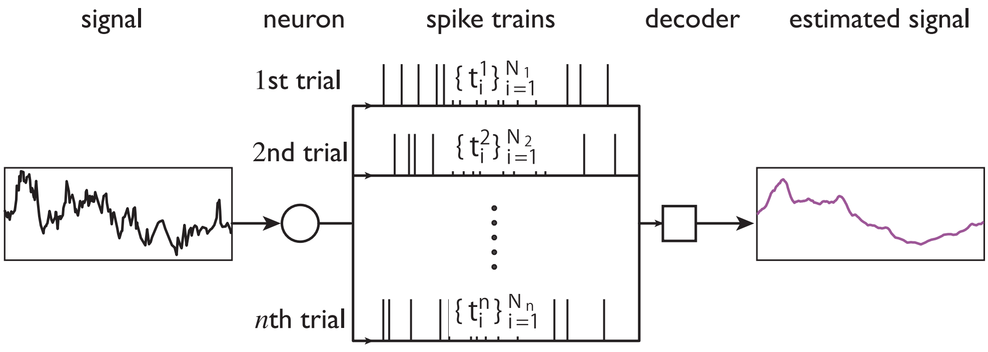


Figure 2: Schematic diagram of neural coding.

Efficient Iterative Method for Constrained Nonconvex Sparse Optimization

Nonconvex optimization problem

A mathematical model for minimizing (or maximizing) a given objective function subject to constraints is called a mathematical optimization problem. A mathematical optimization problem in which the objective function and the constraint set are convex is called a convex optimization problem. For any convex optimization problem, a necessary condition for optimality is also a sufficient condition. Thus, a global optimal solution is found by computing a solution that satisfies the necessary condition. On the other hand, a mathematical optimization problem without the convexity above is called a nonconvex optimization problem. For a nonconvex optimization problem, a solution that satisfies the necessary condition may be a local optimal solution or a stationary point. Although there are a number of studies on global optimization, it is difficult to find a global optimal solution of a large-scale instance arising from machine learning in general. As for machine learning, it is practically sufficient to obtain a solution that satisfies a necessary condition and has small objective value.

Nonconvex sparse optimization problem

A mathematical optimization problem with an additional term in the objective function or an additional constraint for finding a sparse solution with small objective value is called a sparse optimization problem. The least squares problem with the l_1 norm regularizer is well-known Lasso. Because the l_1 norm regularizer is convex, the resulting sparse optimization problem is convex if the original objective function and the constraint set are convex. Hence, we can solve such a problem using techniques in convex optimization. Recently, for finding more sparse solutions, nonconvex regularizers are often used. The resulting sparse optimization problem is nonconvex.

Efficient iterative method for constrained nonconvex sparse optimization

This year, we studied an efficient iterative method for a convex constrained nonconvex sparse optimization problem (Figure 1). In this problem, we use a commonly used nonconvex sparse regularizer written as the difference of the l_1 norm and a convex function. When we appropriately apply the DC algorithm, which is an algorithm for solving a nonconvex optimization problem, we can find a stationary point by solving a simple subproblem (Figure 2) repeatedly. We found an efficient computation for solving the subproblem for several constraint sets arising from important applications (Figure 3). As a result, we showed that our DC algorithm efficiently finds a sparse stationary point with small objective value (Figure 4).

Mirai Tanaka

$$
\begin{array}{ll}
\text{minimize} & l(\boldsymbol{x}) + \underbrace{\lambda\|\boldsymbol{x}\|_1 - \phi(\boldsymbol{x})}_{\text{sparse regularizer}} \\
\text{subject to} & \boldsymbol{x} \in S
\end{array}
$$

Figure 1: Our nonconvex sparse optimization problem.

$$
\begin{array}{ll}
\text{minimize} & \dfrac{1}{2}\|\boldsymbol{x} - \boldsymbol{v}\|_2^2 + \gamma\|\boldsymbol{x}\|_1 \\
\text{subject to} & \boldsymbol{x} \in S
\end{array}
$$

Figure 2: Subproblem arising from our DC algorithm.

Constraint set S	Applications	Solving subproblem
Box	sign or box constrained linear or logistic regression	closed form
ℓ_2 norm ball	PCA	closed form
Standard simpex	least squares over the standard simplex	projection
Box + single linear	dual C-SVM, mean variance portfolio selection, smooth nonlinear continuous knapsack problem	bisection

Figure 3: Simple constraint sets.

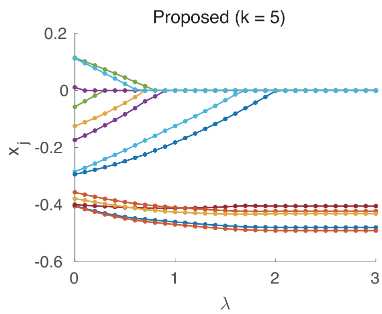


Figure 4: Solution path corresponding to sparse solutions.

Methodology Development for Data-Driven Materials Discovery

With state-of-the-art technologies in data science, we aim to discover novel functional materials. Target materials include drugs, dyes, solvents, polymers, polymeric composites and nanostructured materials. With the comprehensive technologies of machine learning, such as Bayesian modeling, kernel methods, natural language processing, sparse learning and optimization theory, the mission of this research is to create the fundamental methodology and research infrastructures of Materials Informatics.

■ Role of data science in materials discovery

The design space of materials development is considerably high-dimensional. For instance, the chemical space of organic compounds consists of 1060 potential candidates. The challenge is to discover novel materials from the huge landscape that exhibit desirable material properties. In the traditional procedure, computational chemistry methods, such as the first principle calculation, have been used as the central analytic tool. Scientists hypothesize material structures based on experience and intuition, and properties of the designed materials are assessed computationally and experimentally. With the great success of machine learning in many other fields, scientists now realize that the data-driven approach is a promising alternative to achieve enormous savings on time and costs in the laborious, replacing the time-consuming conventional trial-and-error procedure.

■ Bayesian approach to data-driven materials discovery

The aim of our study is to create a novel material design method by the integration of machine learning and Bayesian inference. The method begins by obtaining a set of machine learning models to predict properties of input material structures for multiple design objectives. These models are inverted to the backward model through the Bayes' theorem. Then, we have a posterior probability distribution, which is conditioned by the desired properties. Exploring high probability regions of the posterior, it is expected to identify new materials possessing the desired target properties.

Stephen Wu

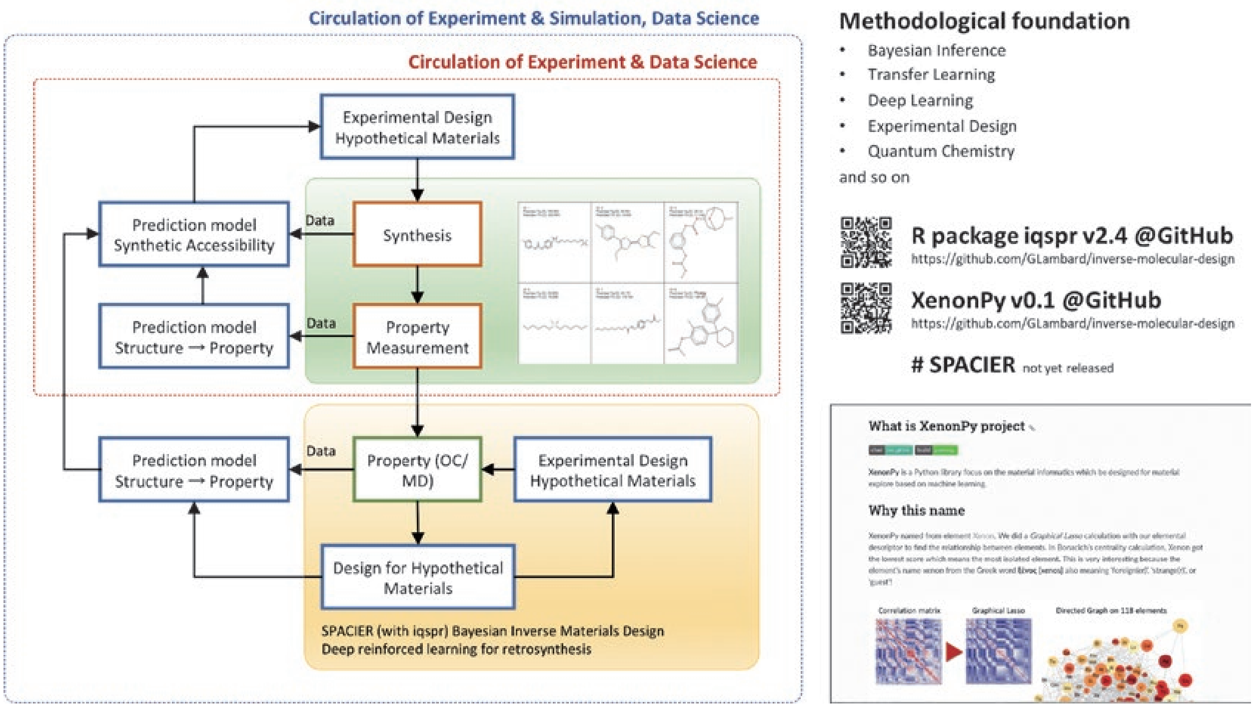


Figure: Integration of Bayesian inference and machine for material design.

Data Science Center for Creative Design and Manufacturing

Mission statement

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

Smart manufacturing

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

Creative design and manufacturing

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

Ryo Yoshida

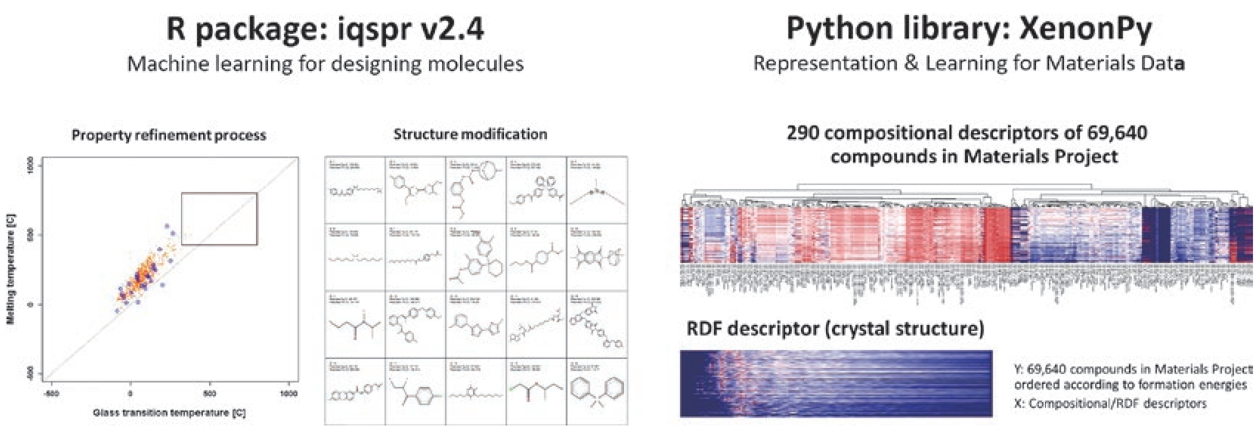


Figure: Software developments for materials informatics.

Longitudinal Data Analysis in Medical and Health Data Science

Longitudinal data analysis

In longitudinal data analysis, analytical methods that take correlation or variance covariance into account have been developed. For example, a mixed effects model with a random intercept is popular, but this model is very simple. When the responses to an intervention vary across subjects, the model fit is bad, and the estimates tend to be biased depending on the missing situation. The autoregressive linear mixed effects model we propose provides a unique variance covariance structure considering the variation in responses to the intervention and the influence of the past treatment history. We are developing methods for analyzing longitudinal data, aiming to elucidate dynamics such as the relationship between the dose of drug and the efficacy and safety measurements over time.

Comparison before and after intervention in randomized controlled trials

It is said that the contribution of statisticians in medicine is in research designs rather than statistical methods. Randomized controlled trials are conducted to ascertain whether a new treatment is effective. This research design guarantees comparability between groups. Now, what analytical method should be used in randomized controlled trials? The distributions of baseline values are expected to be equal between groups, but after intervention, not only the averages but also the shapes of the distributions may change. Some analytical methods are not robust to the difference in shapes, and others are robust when the numbers of subjects are equal between groups. In this way, we are studying analytical methods related to research designs.

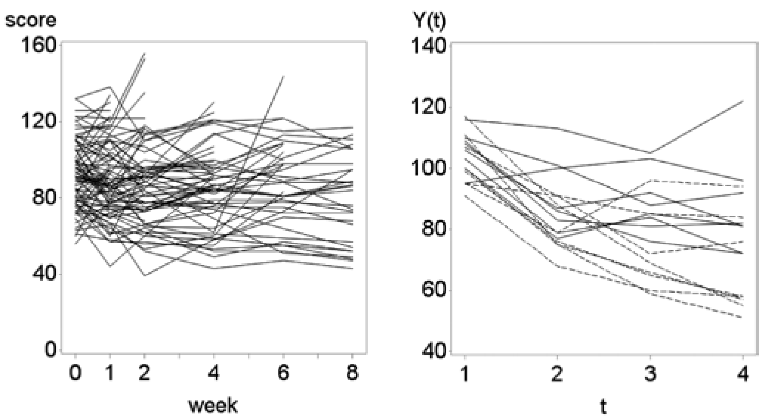


Figure 1: Longitudinal data with dropouts (left). Longitudinal data in a randomized controlled trial (right).

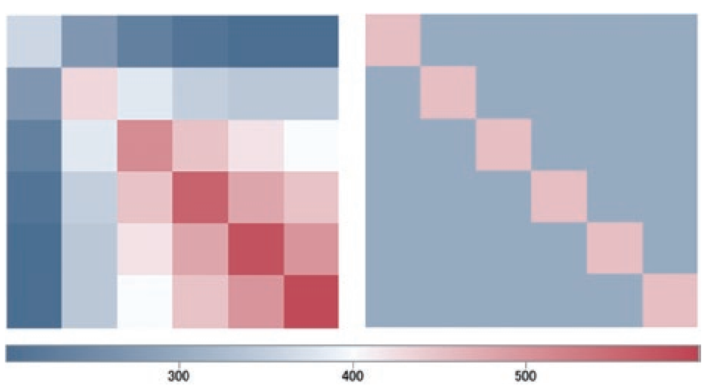


Figure 2: Variance covariance matrices in autoregressive linear mixed effects model (left) and mixed effects model with a random intercept (right).

Long term trends in health indicators

In preventive medicine, it is considered that the early life experience may affect health at older age. In this case, a long-term perspective is important. Although repeated cross-sectional surveys by random sampling have not been introduced much in medical research designs, there are surveys that last over 70 years, and this research design can reveal long-term trends in health indicators. We are studying how to evaluate the long-term impacts of changes in demographics and long-term lifestyle factors such as diet, exercise, smoking and drinking alcohol, and how to use the findings to elucidate causes of diseases and death to prevent them. We aim to leave a healthier society to the next generation.

Ikuko Funatogawa

Publication Bias in Meta-Analysis

Meta-analysis in medical research

Meta-analysis is statistical analysis in which statistical results from some studies with a common purpose are combined to obtain an overall result with higher evidence. Typical examples of meta-analysis in medical research are found in clinical trials to verify effects of new drugs and epidemiological studies to explore causes of some diseases. For example, in randomized clinical trials where a new drug and an existing drug are compared, it is possible to obtain an overall result to support the effect of the new drug, even if each trial does not necessarily support it.

Publication bias

In meta-analysis, the data from each study tends to be biased since it can be obtained only from published sources. For example, statistically significant results tend to be published in clinical trials and epidemiological studies with two-group comparison, and therefore the result of meta-analysis should be also statistically significant if such published results are combined. This sort of bias is called publication bias. Figure 1 shows results of clinical trials to verify that some drug prevents premature birth. The horizontal and vertical axes show estimates of log-odds ratios and reciprocals of their standard errors from the trials. Since the standard errors are larger and the results do not tend to be statistically significant in the bottom, the skewed plot implies that there exists publication bias. This type of plot is called a funnel plot, which is often used to check existence of publication bias.

Worst-case evaluation

A strong assumption on the publication process is necessary to adjust for publication bias. Since it cannot be verified from observed data, it is recommended to conduct a sensitivity analysis, where we check how the overall results are changed according to possible change of the assumptions. However, this is a difficult problem and we made worst-case evaluation under the weaker assumption that statistical results with larger standard errors are more unlikely to be published. Figure 2 shows the possible ranges of overall confidence intervals (real curves) and the upper bounds of overall P-values (dotted curves) by unpublished studies for meta-analysis of the data shown in Figure 1. This figure implies that the significance of the overall result may change if the number of unpublished studies is over 13.

Masayuki Henmi

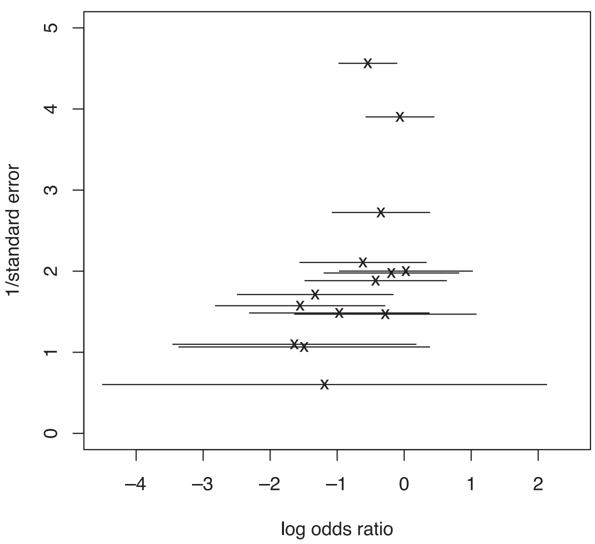


Figure 1: Funnel plot.

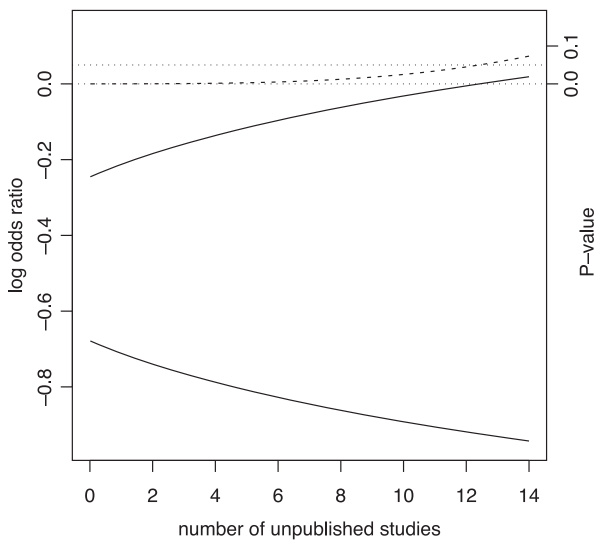


Figure 2: Worst-case confidence intervals and P-values.

NOE (Network Of Excellence) Project

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 along two lines of basic research, as well as NOE (Network of Excellence)-type research and professional development. Research and education efforts are conducted by basic research departments along a horizontal axis, and the NOE-type research centers and the school for professional development are organized along a vertical axis (Figure 1). By its nature, the basic research departments (along the horizontal axis) cuts across and links 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. For that reason, we have chosen not to refer to these efforts as “fundamental research” or “foundational research,” but instead as “basic research”, in order to reflect both the fixed and evolving qualities of statistical mathematics. There are three basic research departments: Statistical Modeling, Statistical Data Science, and Statistical Inference and Mathematics. These departments engage in cutting-edge research aimed at developing methodologies for rational prediction and decision making, based on data and existing knowledge. We regularly assess whether our research system is functioning effectively from the viewpoints of research trends and prospects in statistical mathematics. Pursuant to these assessments, on April 1, 2018, we reorganized basic research departments. All tenured research staff in ISM are assigned in principle to one of these basic research departments.

On the other hand, the NOE-type research centers and the school for professional development (along the vertical axis) are staffed by permanent researchers within ISM, project professors/researchers (post-doctoral staff), and visiting professors and researchers. In addition, we reorganized the NOE-type research centers in Japanese academic year 2017–2018. Five NOE-type research centers have been established: Risk Analysis Research Center, Research and Development Center for Data Assimilation, Research Center for Statistical Machine Learning, Data Science Center for Creative Design and Manufacturing, and Research Center for Medical and Health Data Science (established on April 1, 2018). These centers conduct research activities that interface statistical mathematics with individual scientific disciplines in order to find solutions to urgent social problems.

The School of Statistical Thinking is devoted to professional development, and also provides multiple programs aimed at fostering and promoting statistical thinking. In the School of Statistical Thinking, researchers, students, and contract researchers from private companies who seek to create a new statistical research field, as well as various other people who recognize the necessity of statistics in their particular research field, train together to foster statistical thinking. Of special importance, young project researchers receive on-the-job training from their senior mentors and thereby obtain assorted skills related to statistical thinking. In 2017, we initiated several programs for professional development at various levels; these include the Big Data Analysis Research lecture and training program for engineers in private companies, and the Leading DAT (Leading Data Analytics Talents) lecture and training program, which was designed specifically to train data scientists who have knowledge and skills related to data-centric science in modern society. Please refer to the page “Project of Fostering and Promoting Statistical Thinking” for more details.

NOE (Network Of Excellence) 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. This Japanese academic year (2018–2019) is the ninth year since the beginning of the project. We have reorganized to promote the project more effectively, considering the needs of each community as well as modern society as a whole.

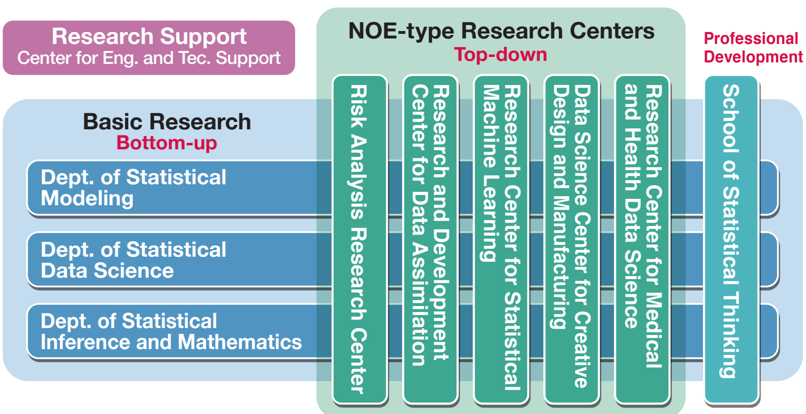


Figure 1: Biaxial structure for research and education.

We set up the new NOE-type research center "Research Center for Medical and Health Data Science" on April 1, 2018. This center aims to promote cutting-edge research and education in the field of medical and health science, based on the research network that ISM has established in this field to date. As of this Academic year (2018–2019), the research activities of the NOE Project have been expanded to six fields: Risk Research, Next-generation Simulation, Survey Science, Statistical Machine Learning, Data Science for Creative Design and Manufacturing, and Medical and Health Data Science (Figure 2).

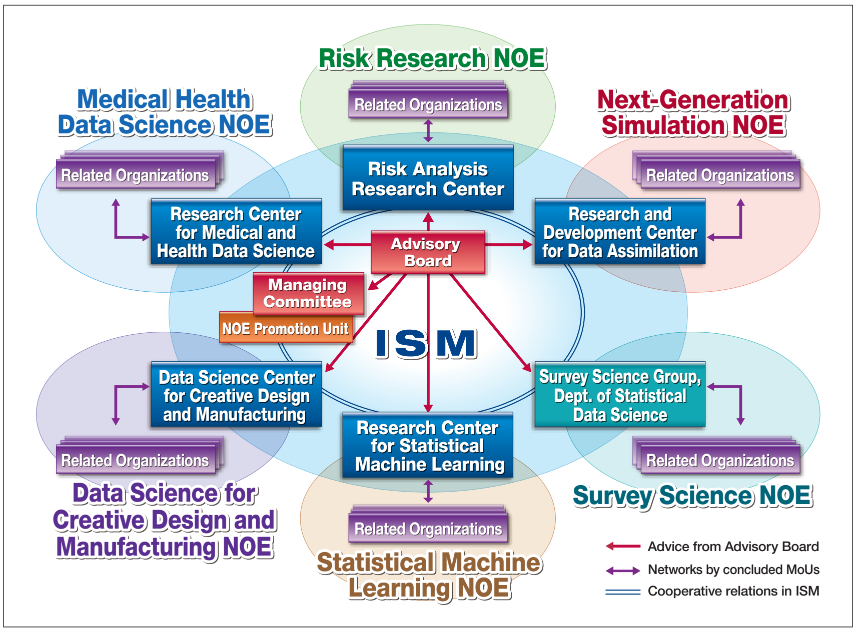


Figure 2: Relationship diagram of the NOE Project.

Future Conception of NOE Activities

To fulfill the goal of establishing new scientific methodologies ("Fourth Paradigm") in a knowledge-based society, in which the importance of knowledge goes beyond merely solving individual problems, NOE activities are being systematically pursued under the unified project guidelines formulated by the Managing Committee of NOE Project. At the same time, advice is also taken from the members of the Advisory Board of NOE Project (Table 1), which is made up of experts from the industrial, academic, and government sectors.

The NOE Project, which is made possible by ISM's special focus in the cross-disciplinary field of "statistical mathematics," is attracting strong support from each of these communities. 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. ISM continues to promote this NOE Project.

Director of the Center for Materials Research by Information Integration, MDIS, National Institute for Materials Science	Dr. Satoshi Itoh
Professor Emeritus, Tokyo Institute of Technology	Dr. Takatoshi Imai
Professor Emeritus, The University of Tokyo	Dr. Yoshio Oyanagi
President, The Japan Pharmaceutical Manufacturers Association	Mr. Yoshihiko Hatanaka
President, Toyota Technological Institute at Chicago	Dr. Sadaoki Furui
Director-General, Institute for Monetary and Economic Studies, Bank of Japan	Mr. Shigenori Hiratsuka

Table 1: Advisory Board of NOE Project. (As of April 1, 2018)

As described above, the NOE-type research centers and the group serve as core hubs in their respective fields. ISM is promoting the signing of MOUs (Memorandum of Understanding) with research organizations within Japan and overseas, and the number of MOUs is increasing each year, including MOUs that span multiple NOE research fields. The goal of ISM is general research in statistical mathematics, which is in demand by various research fields in both the humanities and science. ISM must respond flexibly to requests from each community and contribute to them. Reorganization over recent years, based on the needs of each community, has aimed at much deeper promotion of the NOE Project.

With its focus on methodology, ISM continues to plan research in each of the five NOE research fields. Furthermore, with all research activities concentrated under the umbrella of NOE Research Promotion, the general body that oversees the five NOEs, ISM is expanding and developing its NOE projects with the aim of establishing new scientific methodologies ("Fourth Paradigm"), creating new research disciplines, and developing new styles of joint research. For up-to-date information on the research structures of the NOE Project, please visit the website. We very much appreciate your continued support for this Project.

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

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 no academic institution other than ISM has a Ph. D. course in statistics and the small number of statisticians in academia are isolated from each other, being scattered over various disciplines. Hoping to gain a little traction on this problem, ISM established the School of Statistical Thinking, into which we integrated all of our educational resources. In FY 2016, ISM established the Managing Committee of School of Statistical Thinking, inviting contributions from outside experts, and in FY 2017 we launched the Leading DAT program by adopting the suggestions by the committee. The following are the principal projects.

Research Collaboration Startup

The Institute had already been providing a consultation service for statistical science, but along with the launch of the School of Statistical Thinking in November 2011, this service was reorganized as a research collaboration startup. This program, being one of the projects to foster and promote statistical thinking, is mainly aimed at supporting applied scientists and other non-experts. Expert statisticians affiliated with the Institute give them advice on statistical modeling, data analysis, and research. Some cases have developed into official research collaborations, which are our primary duty as an inter-university research institute. The Institute accepts more than 50 cases annually, some of which benefit society in diverse ways.

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 2017, five workshops have been accepted after review.

Open Lecture

We hold an open lecture during Education and Culture Week every year (November 1 through 7), to introduce the Institute’s activities and to promote statistical science. We invite lecturers to speak on a timely topic relating to statistical science. The lecture is open to the general public. For further information, please visit the website of the Institute of Statistical Mathematics.

http://www.ism.ac.jp/kouenkai/

Statistical Mathematics Seminar Series

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

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

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.

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. As the program’s first projects, we organized two Leading DAT lectures entitled “L-B1 Bayesian Modeling in Practice” and “L-B2 Machine Learning and Modern Methodologies in Data Science.” At the same time, we established the Leading DAT Training Course, in which we grant certificates to participants who have fulfilled the course requirements, including attendance in all lectures and submission of reports. A total of 25 people have been granted the certificate of completion.

Certificate ceremony

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 the 2017 academic year, 13 courses (including Leading DAT Lectures) were held and the number of participants was 968. The total number of courses held from 1969 to March, 2018 was 362, with a total of 25,991 participants. These courses 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.

http://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 materiel pour l'Information et la Communication Avancee	France (Paris)	February 9, 2015
Le laboratoire de mathematiques 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, 2015
The University of Porto	Portugal (Porto)	June 22, 2015
Natinonal 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 Evola	Portugal (Evola)	November 30, 207
Universität Ulm	Germany (Ulm)	December 8, 2017
The Korean Association for Survey Research	The Republic of Korea (Seoul)	February 14, 2018

* 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	2012	2013	2014	2015	2016	2017
Number of Activities	182	181	177	183	187	161

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	Spatial and Time Series Modeling Group	f	Structure Exploration Group
b	Complex System Modeling Group	g	Mathematical Statistics Group
c	Latent Structure Modeling Group	h	Learning and Inference Group
d	Survey Science Group	i	Computational Inference Group
e	Metric Science Group	j	Others

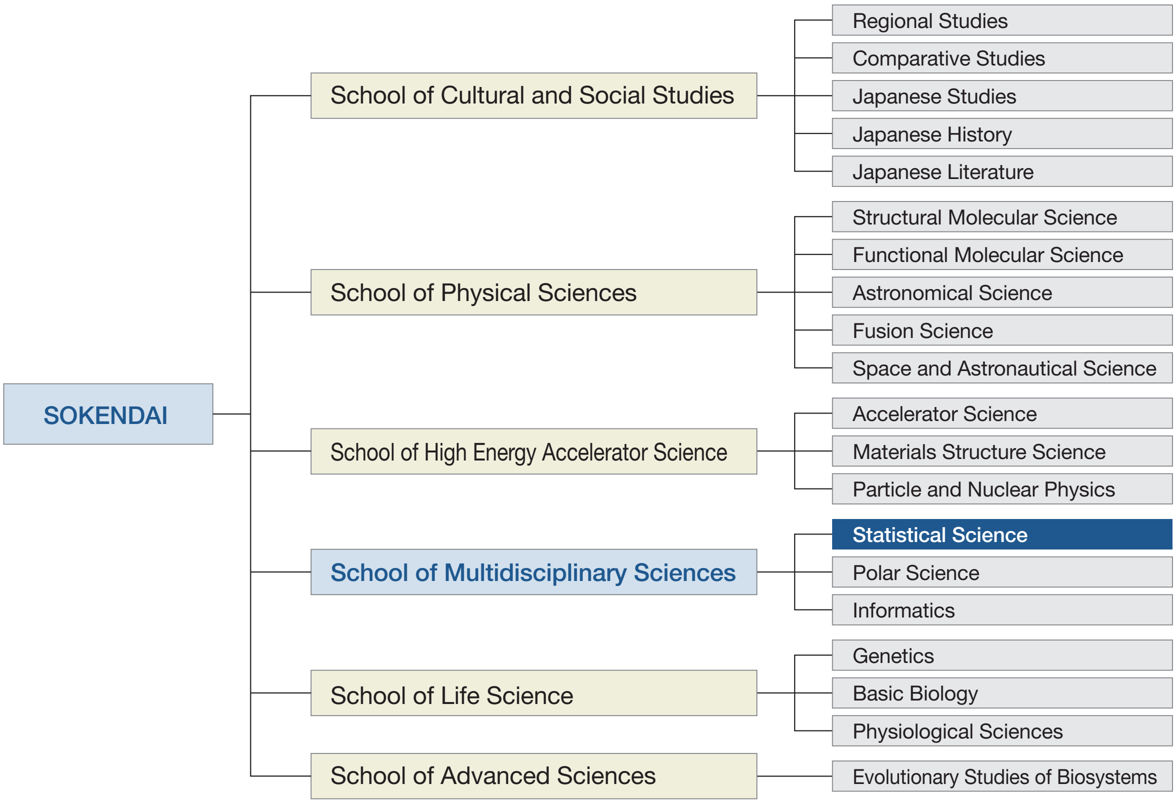
Major Research Fields

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

Graduate School Program

Organization

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



Outline of Education and Research

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

Field of Education and Research	Contents
Statistical Modeling	Education and research focuses on dynamic modeling such as spatial and space-time modeling, graphical modeling of temporally and/or spatially inter-related complex phenomena, and intelligent information processing. We also provide education and research on statistical inference based on various models, methods of calculation for inference, and evaluation of models based on data.
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.
Mathematical Analysis and Statistical Inference	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, 2018)

■ Doctor's course five years:Quota,2

Year of enrollment	2010	2013	2014	2016	2017	2018
Number of students	1	1	1	1	2	1

■ Doctor's course three years:Quota,3

Year of enrollment	2013	2014	2015	2016	2017	2018
Number of students	1 ①	3 ③	1 ①	5 ④	4 ③	4 ③

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

University Background of Students

National and public universities

• Hokkaido University (4) • Tohoku University (3) • Fukushima University (1) • University of Tsukuba (6) • 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 (5) • The University of Tokyo (14) • Tokyo Metropolitan University (1) • Tokyo University of Agriculture and Technology (1) • Hitotsubashi University (6) • Shizuoka University (1) • Japan Advanced Institute of Science and Technology (1) • Nagoya University (3) • 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 (2) • Oita University (1)

University Background of Students

Private universities

• Kitasato University (1) • Keio University (8) • Shibaura Institute of Technology (1) • Chuo University (8) • 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) • 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) • Institute of Applied Mathematics, AMSS, CAS (1) • University of Science and Technology of China (1) • Center for Analysis and Prediction, China Seismological Bureau (1) • Northeastern University (1) • The Hong Kong University of Science and Technology (1)

Degrees Awarded

Year	2012	2013	2014	2015	2016	2017
Doctor of Philosophy	6 [1]	6	5	5	7	5

* [ ] Ph.D. on the basis of the dissertation only (included in the total)

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

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

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. • Bank of Tokyo-Mitsubishi UFJ • 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

Facilities and Equipment

Computational Resources (As of April 1, 2018)

ISM is now maintaining two different supercomputer systems. One is the Supercomputer System for Statistical Science (called System "I") which is going to be replaced by a new one during FY2018. The other system is Communal Cloud Computing System (called System "C") introduced at the end of FY2013.

System "I" is a large distributed-memory supercomputer that consists of 400 nodes of SGI ICE-X with Ivy Bridge and 136 Haswell nodes, having 12,864 cores in total. The system also includes a large-scale shared storage system (2.5 PB disk storage) physical random number generator boards, and a visualization system that supports the maximum resolution of 4,096 * 2,160 and has a 200-inch rear projection screen for 3D visualization.

ISM is going to replace the present System "I" by a new one, HPE SGI 8600 Supercomputer System during FY2018. The new system will have nearly four times computing power, and the total main memory will expand to 144TB. It will also have several accelerator nodes each of which has four NVIDIA Tesla P100 boards.

System "C" consists of 64 Dell PowerEdge R620 (two 10-core Xeon E5-2680v2, 256GB memory). This system provides easy-to-use computing environments such as distributed-memory statistical computing environments and Web servers, running on Apache CloudStack software. This private cloud system is also used in hosting data analysis competition events.

In the main office, 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 systems I and C are all connected to this network. A wireless LAN system is also available in the immediate area of the building occupied by the institute. 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).

The Supercomputer System for Statistical Science

The Communal Cloud Computing System

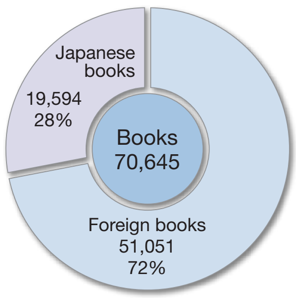
Supercomputer System HPE SGI 8600

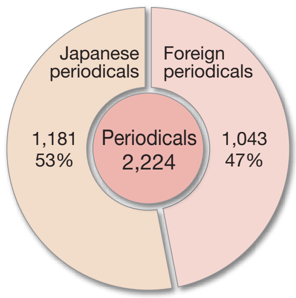
Library and Materials (As of April 1, 2018)

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 (2017)

Type	Personnel expenses	Non-personnel expenses	Total
Expenditure	704,938	926,658	1,631,596

Unit: 1,000JPY

Accepted External Funds (2017)

Type	Joint research	Subcontracted research, Trustee business	Contract researchers	Academic Consulting	Contribution for scholarship	Total
Items	25	18	6	6	8	63
Income	38,802	135,391	1,533	4,193	9,859	189,778

Unit: 1,000JPY

Grant-in-Aid for Scientific Research "KAKENHI" (2017)

Research Category	Items	Amount Granted
Grant-in-Aid for Scientific Research on Innovation Areas	1	10,790
Grant-in-Aid for Scientific Research (S)	—	—
Grant-in-Aid for Scientific Research (A)	4	40,040
Grant-in-Aid for Scientific Research (B)	9	31,070
Grant-in-Aid for Scientific Research (C)	23	29,783
Grant-in-Aid for Challenging Exploratory Research	1	1,040
Grant-in-Aid for Young Scientists (B)	11	8,745
Grant-in-Aid for Research Activity Start-up	2	2,730
Grant-in-Aid for JSPS Fellows	3	4,550
Total	54	128,748

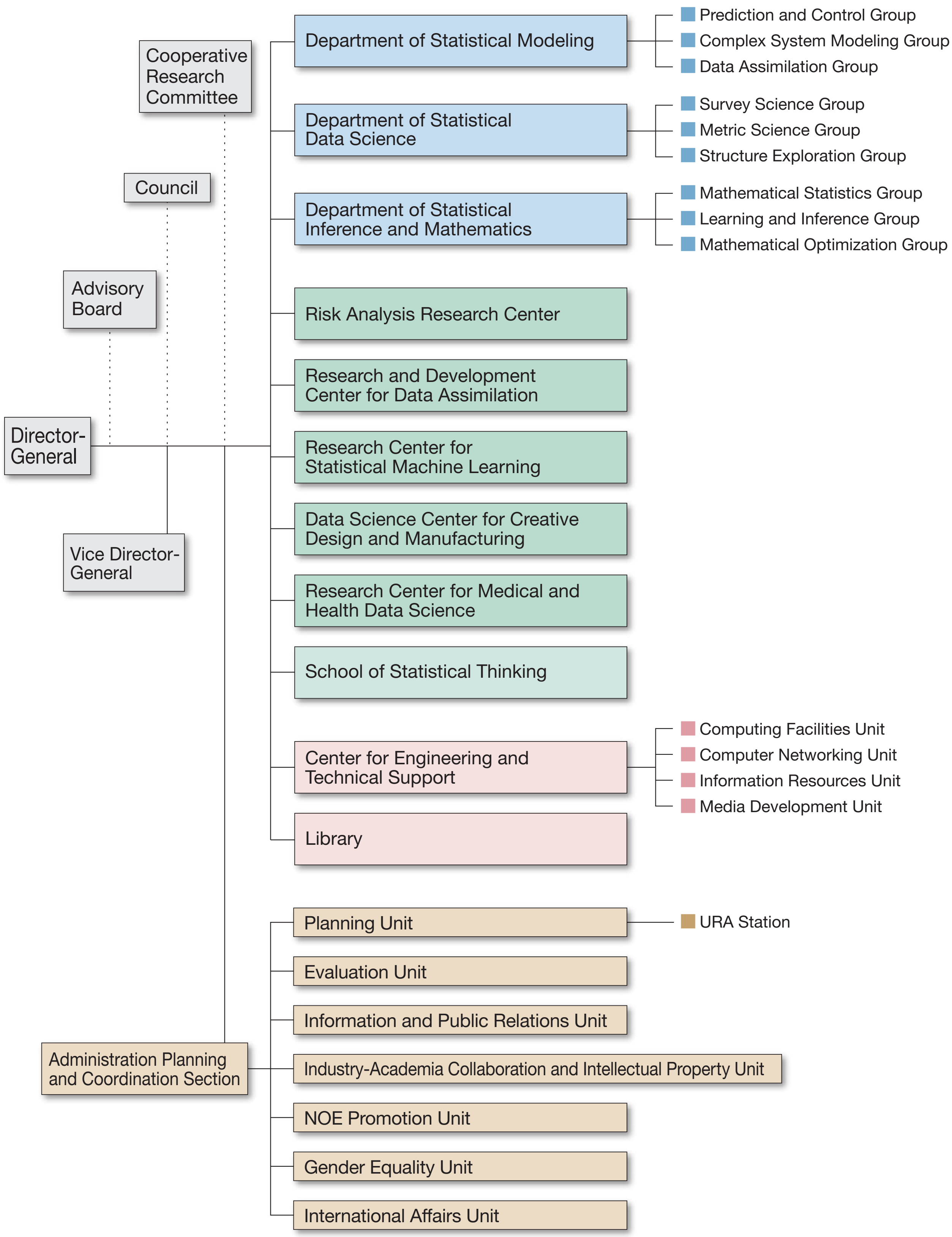
Unit: 1,000JPY

Site and Buildings (As of April 1, 2018)

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

Organization

Organization Diagram (As of April 1, 2018)



Number of Staff (As of April 1, 2018)

Type	Director-General	Professor	Associate Professor	Assistant Professor	Administ-rative Staff	Technical Staff	Total
Director-General	1						1
Department of Statistical Modeling		6	7	2			15
Department of Statistical Data Science		5	6	4			15
Department of Statistical Inference and Mathematics		7	5	3			15
School of Statistical Thinking				1			1
Center for Engineering and Technical Support						11	11
Administration Planning and Coordination Section					1		1
Tachikawa Administration Department					(35)		(35)
Total	1	18	18	10	1 (35)	11	59 (35)

( ) 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, 2018)

Director-General	Tomoyuki HIGUCHI

Vice Director-General	Satoshi ITO	Vice Director-General	Satoshi YAMASHITA	Vice Director-General	Koji KANEFUJI

Department of Statistical Modeling

Director Junji NAKANO

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.	Yukito IBA	Assoc. Prof.	Kazuhiro MINAMI	Assoc. Prof.	Shinsuke KOYAMA
Assoc. Prof.	Hideitsu HINO	Assist. Prof.	Momoko HAYAMIZU		

Data Assimilation Group

Prof.	Tomoyuki HIGUCHI	Prof.	Junji NAKANO	Prof.	Genta UENO
Assoc. Prof.	Shinya NAKANO	Assist. Prof.	Shunichi NOMURA	Visiting Assoc. Prof.	Yuji MIZUKAMI

Department of Statistical Data Science

Director Tomoko MATSUI

Survey Science Group

Prof.	Ryozo YOSHINO	Assoc. Prof.	Tadahiko MAEDA	Assoc. Prof.	Yoo Sung PARK
Assist. Prof.	Masayo HIROSE	Project Assist. Prof.	Yusuke INAGAKI	Project Assist. Prof.	Kiyohisa SHIBAI
Project Researcher	Naoko KATO	Visiting Prof.	Takatoshi IMADA	Visiting Prof.	Toru KIKKAWA

Staff

Department of Statistical Data Science

Visiting Prof.	Yoshimichi SATO	Visiting Prof.	Wataru MATSUMOTO	Visiting Prof.	Masahiro MIZUTA
Visiting Prof.	Saeko KIKUZAWA	Visiting Assoc. Prof.	Koken OZAKI	Visiting Assoc. Prof.	Tadayoshi FUSHIKI
Visiting Assoc. Prof.	Taisuke FUJITA				

Metric Science Group

Prof.	Satoshi YAMASHITA	Prof.	Koji KANEFUJI	Prof.	Yoichi ITO
Assoc. Prof.	Ikuko FUNATOGAWA	Assoc. Prof.	Hisashi NOMA	Assist. Prof.	Nobuo SHIMIZU
Project Researcher	Hiroka HAMADA	Visiting Prof.	Shizue IZUMI		

Structure Exploration Group

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

Department of Statistical Inference and Mathematics

Director Satoshi KURIKI

Mathematical Statistics Group

Prof.	Satoshi KURIKI	Prof.	Yoshiyuki NINOMIYA	Assoc. Prof.	Shuhei MANO
Assoc. Prof.	Shogo KATO	Assoc. Prof.	Takaaki SHIMURA	Assist. Prof.	Teppei OGIHARA
Visiting Prof.	Akimichi TAKEMURA				

Learning and Inference Group

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

Mathematical Optimization Group

Prof.	Satoshi ITO	Prof.	Shiro IKEDA	Assist. Prof.	Mirai TANAKA
Visiting Prof.	Eitarou AIYOSHI				

Risk Analysis Research Center

Director Satoshi YAMASHITA Vice Director Shogo KATO

Prof.	Satoshi YAMASHITA	Prof.	Satoshi KURIKI	Prof.	Shinto EGUCHI
Prof.	Koji KANEFUJI	Prof.	Atsushi YOSHIMOTO	Prof.	Yoshinori KAWASAKI
Assoc. Prof.	Masayuki HENMI	Assoc. Prof.	Fumikazu MIWAKEICHI	Assoc. Prof.	Jiancang ZHUANG
Assoc. Prof.	Kenichiro SHIMATANI	Assoc. Prof.	Ikuko FUNATOGAWA	Assoc. Prof.	Shogo KATO
Assoc. Prof.	Yumi TAKIZAWA	Assoc. Prof.	Hisashi NOMA	Assoc. Prof.	Shuhei MANO
Assoc. Prof.	Kazuhiro MINAMI	Assoc. Prof.	Takaaki SHIMURA	Assist. Prof.	Teppei OGIHARA
Assist. Prof.	Shunichi NOMURA	Project Assist. Prof.	Shizu ITAKA	Project Assist. Prof.	Hayafumi WATANABE
Project Assist. Prof.	Yuta TANOUE	Project Assist. Prof.	Takao KUMAZAWA	Project Assist. Prof.	Junchao ZHANG
Project Assist. Prof.	Yicun GUO	Project Researcher	Yuma UEHARA	Project Researcher	Hideaki NAGAHATA
Visiting Prof.	Rinya TAKAHASHI	Visiting Prof.	Toshikazu KITANO	Visiting Prof.	Yo SHIINA
Visiting Prof.	Naoki SAKAI	Visiting Prof.	Mihoko MINAMI	Visiting Prof.	Satoshi TAKIZAWA
Visiting Prof.	Toshihiro HORIGUCHI	Visiting Prof.	Shunji HASHIMOTO	Visiting Prof.	Yasuhiro KUBOTA
Visiting Prof.	Naoto KUNITOMO	Visiting Prof.	Toshio HONDA	Visiting Prof.	Hideatsu TSUKAHARA

Risk Analysis Research Center

Visiting Prof.	Hiroshi TSUDA	Visiting Prof.	Michiko MIYAMOTO	Visiting Prof.	Tadashi ONO
Visiting Prof.	Satoshi FUJII	Visiting Prof.	Takaaki YOSHINO	Visiting Prof.	Masakazu ANDO
Visiting Prof.	Sadaaki MIYAMOTO	Visiting Prof.	Shinsuke ITO	Visiting Prof.	Toshinao YOSHIBA
Visiting Prof.	Nakahiro YOSHIDA	Visiting Prof.	Masaaki FUKASAWA	Visiting Prof.	Yasutaka SHIMIZU
Visiting Assoc. Prof.	Hisayuki HARA	Visiting Assoc. Prof.	Takashi KAMEYA	Visiting Assoc. Prof.	Kenichi KAMO
Visiting Assoc. Prof.	Masashi KONOSHIMA	Visiting Assoc. Prof.	Tetsuji TONDA	Visiting Assoc. Prof.	Takaki IWATA
Visiting Assoc. Prof.	Bogdan Dumitru ENESCU	Visiting Assoc. Prof.	Kazuyoshi NANJO	Visiting Assoc. Prof.	Masao UEKI
Visiting Assoc. Prof.	Yukihiko OKADA	Visiting Assoc. Prof.	Seisho SATO	Visiting Assoc. Prof.	Junichi TAKAHASHI
Visiting Assoc. Prof.	Yuta KOIKE	Visiting Assoc. Prof.	Takafumi KUBOTA		

Research and Development Center for Data Assimilation

Director Genta UENO　Vice Director Shinya NAKANO

Prof.	Genta UENO	Prof.	Tomoyuki HIGUCHI	Prof.	Junji NAKANO
Prof.	Yukito IBA	Prof.	Ryo YOSHIDA	Assoc. Prof.	Shinya NAKANO
Project Assoc. Prof.	Masaya SAITO	Assist. Prof.	Stephen WU	Assist. Prof.	Shunichi NOMURA
Assist. Prof.	Daisuke MURAKAMI	Project Researcher	Takashi YAMAMOTO	Visiting Prof.	Kazuyuki NAKAMURA
Visiting Prof.	Shinichi OTANI	Visiting Prof.	Yoichi MOTOMURA	Visiting Prof.	Nobuhiko TERUI
Visiting Prof.	Tadahiko SATO	Visiting Prof.	Masako KAMIYAMA	Visiting Assoc. Prof.	Hiromichi NAGAO
Visiting Assoc. Prof.	Hiroshi KATO	Visiting Assoc. Prof.	Eiji MOTOHASHI	Visiting Assoc. Prof.	Tsukasa ISHIGAKI
Visiting Assoc. Prof.	Yosuke FUJII				

Research Center for Statistical Machine Learning

Director Kenji FUKUMIZU　Vice Director Tomoko MATSUI

Prof.	Kenji FUKUMIZU	Prof.	Tomoko MATSUI	Prof.	Shinto EGUCHI
Prof.	Yoshihiko MIYASATO	Prof.	Satoshi ITO	Prof.	Shiro IKEDA
Prof.	Satoshi KURIKI	Prof.	Hironori FUJISAWA	Assoc. Prof.	Daichi MOCHIHASHI
Assoc. Prof.	Shinsuke KOYAMA	Assoc. Prof.	Kazuhiro MINAMI	Assoc. Prof.	Mirai TANAKA
Assist. Prof.	Daisuke MURAKAMI	Project Assist. Prof.	Mikio MORII	Project Assist. Prof.	Matthew Christopher AMES
Project Researcher	Jin ZHOU	Visiting Prof.	Katsuki FUJISAWA	Visiting Prof.	Takashi TSUCHIYA
Visiting Prof.	Yuji SHINANO	Visiting Prof.	Akiko TAKEDA	Visiting Prof.	Masataka GOTO
Visiting Prof.	Yoshiki YAMAGATA	Visiting Prof.	Arthur GRETTON	Visiting Assoc. Prof.	Makoto YAMADA
Visiting Assoc. Prof.	Tsutomu TAKEUCHI				

Data Science Center for Creative Design and Manufacturing

Director Ryo YOSHIDA　Vice Director Hironori FUJISAWA

Prof.	Ryo YOSHIDA	Prof.	Hironori FUJISAWA	Prof.	Kenji FUKUMIZU
Assoc. Prof.	Shinya NAKANO	Assoc. Prof.	Daichi MOCHIHASHI	Assist. Prof.	Stephen WU
Project Researcher	Hironao YAMADA	Visiting Assoc. Prof.	Terumasa TOKUNAGA		

Staff

Research Center for Medical and Health Data Science

Director Yoichi ITO　　Vice Director Hisashi NOMA

Prof.	Yoichi ITO	Prof.	Satoshi YAMASHITA	Prof.	Shinto EGUCHI
Assoc. Prof.	Hisashi NOMA	Assoc. Prof.	Masayuki HENMI	Assoc. Prof.	Ikuko FUNATOGAWA
Assoc. Prof.	Fumikazu MIWAKEICHI	Project Assoc. Prof.	Kengo NAGASHIMA	Project Assist. Prof.	Mayumi OKA
Visiting Prof.	Yasuo OHASHI	Visiting Prof.	Senichiro KIKUCHI	Visiting Prof.	Ken KIYONO
Visiting Prof.	Toshiya SATO	Visiting Prof.	Satoshi HATTORI	Visiting Prof.	Tatsuhiko TSUNODA
Visiting Prof.	Satoshi TERAMUKAI	Visiting Prof.	Hisateru TACHIMORI	Visiting Prof.	Manabu IWASAKI
Visiting Prof.	Shusaku TSUMOTO	Visiting Prof.	Michiko WATANABE	Visiting Assoc. Prof.	Noriko TANAKA
Visiting Assoc. Prof.	Ryoichi KIMURA	Visiting Assoc. Prof.	Kunihiko TAKAHASHI	Visiting Assoc. Prof.	Kazushi MARUO
Visiting Assoc. Prof.	Atsushi GOTO	Visiting Assoc. Prof.	Masataka TAGURI	Visiting Assoc. Prof.	Ryota NAKAMURA

School of Statistical Thinking

Director Yoshinori KAWASAKI　　Vice Director Genta UENO
Vice Director Yukito IBA

Prof.	Satoshi ITO	Prof.	Yukito IBA	Prof.	Kenji FUKUMIZU
Project Prof.	Yoshiyasu TAMURA	Assoc. Prof.	Kenichiro SHIMATANI	Assoc. Prof.	Masayuki HENMI
Visiting Assoc. Prof.	Naoki KAMIYA	Assist. Prof.	Masaaki IMAIZUMI	Project Assist. Prof.	Mitsuru TOYODA

Center for Engineering and Technical Support

Director Yoshinori KAWASAKI　　Vice Director Jun ADACHI
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 Yoshinori KAWASAKI

Administration Planning and Coordination Section

Chief Director Tomoyuki HIGUCHI

Director of Planning Unit	Satoshi ITO	Director of Evaluation Unit	Koji KANEFUJI
Director of Information and Public Relations Unit	Koji KANEFUJI	Director of Industry-Academia Collaboration and Intellectual Property Unit	Satoshi YAMASHITA
Director of NOE Promotion Unit	Satoshi ITO	Director of Gender Equality Unit	Satoshi ITO
Director of International Affairs Unit	Junji NAKANO		

URA Station

Leader	Kozo KITAMURA	Subleader	Motoi OKAMOTO
Research Administrator	Keisuke HONDA		

Council of The Institute of Statistical Mathematics (As of April 1, 2018)

Keiko TAKAHASHI	Director-General, Japan Agency for Marine-Earth Science and Technology (JAMSTEC) Center for Earth Information Science and Technology (CEIST)
Masahiro MIZUTA	Professor, Information Initiative Center Hokkaido University Graduate School of Information Science and Technology, Hokkaido University
Shigeru OBAYASHI	Director, Institute of Fluid Science, Tohoku University
Nakahiro YOSHIDA	Professor, Graduate School of Mathematical Sciences, University of Tokyo
Masayuki UCHIDA	Professor, Graduate School of Engineering Science, Osaka University
Hiroshi SAIGO	Professor, Faculty of Political Science and Economics, Waseda University
Yasuhiro OMORI	Professor, Faculty of Economics, University of Tokyo
Kikuo MAEKAWA	Professor, Spoken Language Division, Director, Center for Corpus Development National Institute for Japanese Language and Linguistics
Hideki ASOH	Director, National Institute of Advanced Industrial Science and Technology, Department of Information Technology and Human Factors Artificial Intelligence Research Center Deputy
Mihoko MINAMI	Professor, Department of Mathematics, Faculty of Science and Technology, Keio University
Ryozo YOSHINO	Professor, Research Organization of Information and Systems
Satoshi ITO	Professor (Vice Director-General, ISM)
Satoshi YAMASHITA	Professor (Vice Director-General, ISM)
Koji KANEFUJI	Professor (Vice Director-General, ISM)
Junji NAKANO	Professor (Director of Department of Statistical Modeling, ISM)
Tomoko MATSUI	Professor (Department of Statistical Modeling, ISM)
Satoshi KURIKI	Professor (Director of Department of Mathematical Analysis and Statistical Inference, ISM)
Yoshinori KAWASAKI	Professor (Director of Center for Engineering and Technical Support, ISM)
Yoshihiko MIYASATO	Professor (Department of Mathematical Analysis and Statistical Inference, ISM)
Yukito IBA	Professor (Department of Statistical Modeling, ISM)
Kenji FUKUMIZU	Professor (Department of Mathematical Analysis and Statistical Inference, ISM)

Cooperative Research Committee (As of April 1, 2018)

Tadahiko SATO	Professor, Faculty of Business Sciences, University of Tsukuba
Kunihiko TAKAHASHI	Associate Professor, Department of Biostatistics, Nagoya University Graduate School of Medicine
Akinobu TAKEUCHI	Professor, Faculty of Humanities and Social Sciences, Jissen Women's University
Takahiro TSUCHIYA	Professor, Center for Data Science, Yokohama City University
Hiroyuki MINAMI	Professor, Information Initiative Center, Hokkaido University
Junji NAKANO	Professor (Director of Department of Statistical Modeling, ISM)
Koji KANEFUJI	Professor (Director of Department of Data Science, ISM)
Shiro IKEDA	Professor (Department of Mathematical Analysis and Statistical Inference, ISM)
Shinto EGUCHI	Professor (Department of Mathematical Analysis and Statistical Inference, ISM)

Managing Committee of School of Statistical Thinking (As of April 1, 2018)

Satoshi IMURA	Professor, Bioscience Group, National Institute of Polar Research
Yoshimichi OCHI	Trustee, Vice-president, Oita University
Takafumi KUSANO	BrainPad Inc., Representative Director/Co-Founder
Wataru SAKAMOTO	Professor, Graduate School of Environmental and Life Science, Okayama University
Yo SHEENA	Professor, Academic Assembly School of Humanities and Social Sciences Institute of Social Sciences, Shinshu University
Yoshinori KAWASAKI	Director (School of Statistical Thinking, ISM)
Yukito IBA	Vice Director (School of Statistical Thinking, ISM)
Genta UENO	Vice Director (School of Statistical Thinking, ISM)
Satoshi ITO	Professor (Vice Director-General, ISM)
Kenichiro SHIMATANI	Associate Professor (Department of Data Science, ISM)

Research Ethics Review Committee (As of April 1, 2018)

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, Kyoto University Hospital, Institute for Advancement of Clinical and Translational Science Department of EBM Research
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	Shuhei MANO	Associate Professor (Department of Mathematical Analysis and Statistical Inference, ISM)

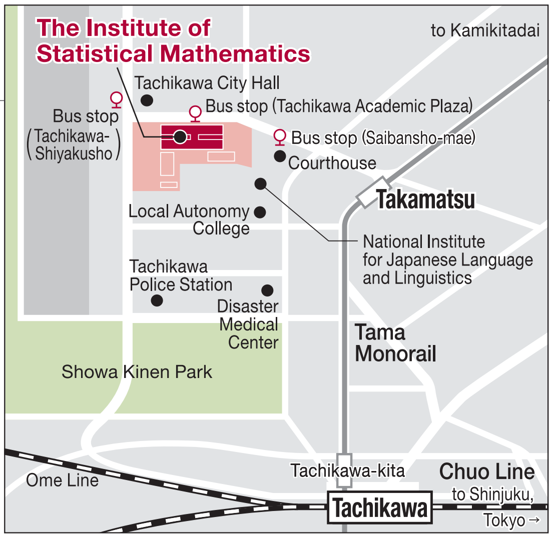
Professor Emeritus (As of April 1, 2018)

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

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	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).



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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