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Kyurizukai

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Studies on Problem Solution

from Keio's Faculty of Science and Technology

The attraction of Operations Research – a scientific approach to solve "Problems" of the world.

Akiko Takeda

Assistant Professor, Department of Administration Engineering

Featured in this issue is Assistant Professor Akiko Takeda who challenges complex problems of our society, taking advantage of Operations Research (OR) techniques.

Using OR to Derive Optimal Solutions

Mathematics takes up the challenge of the actual world

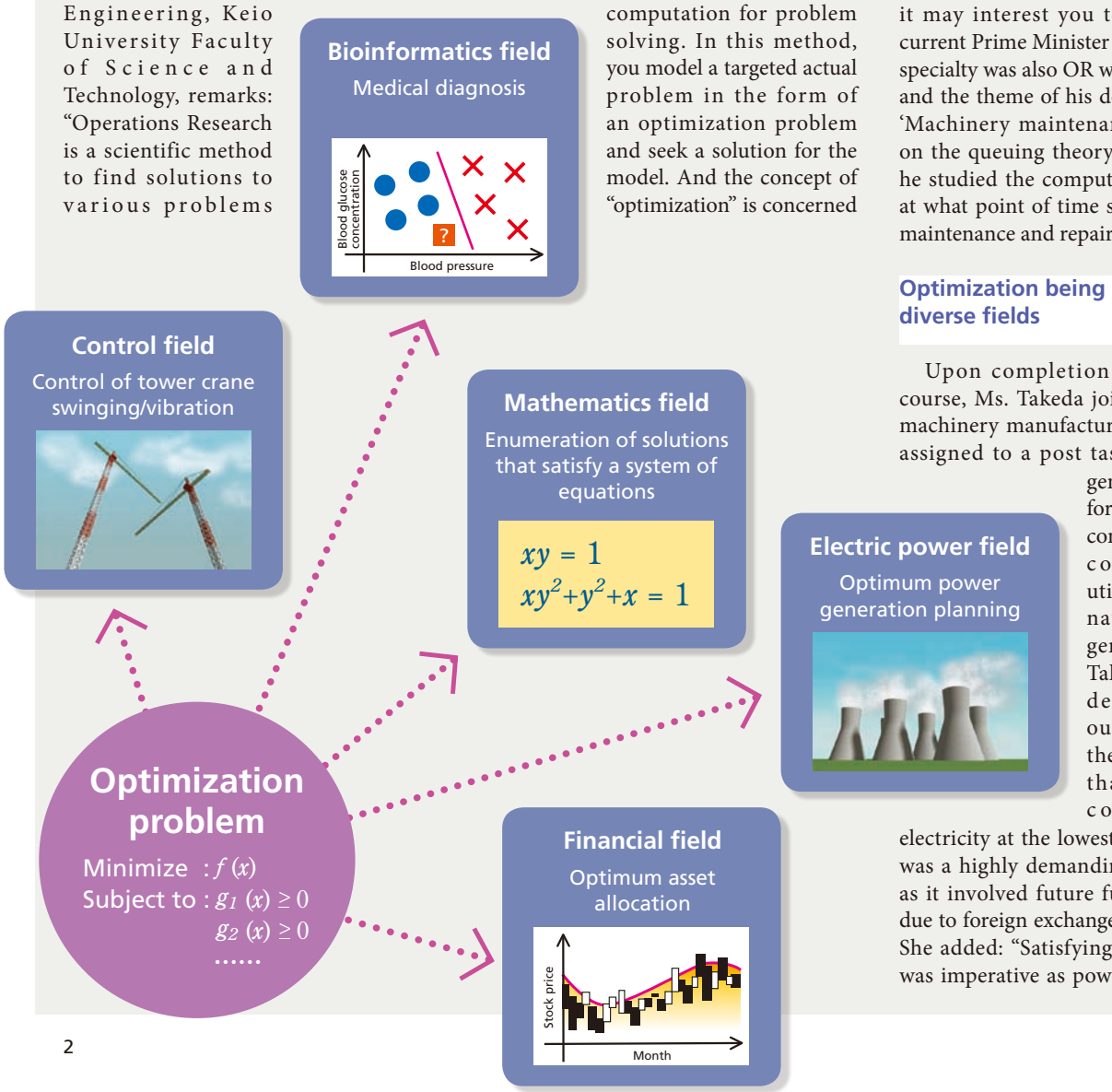
Suppose you intend to reach your destination in a metropolitan area using different modes of public transportation such as JR, private and subway lines, you may be familiar with several different routes but may be at a loss which route to choose. In this type of case, the "train transfer guide" site accessible from your cellular phone or PC is very useful. Capable of instantly receiving the shortest and cheapest route from among the various routes, this convenient tool is the result of a field of applied mathematics known as Operations Research. What type of study is this OR that is inseparable from daily and vital needs of our modern society and Ms. Akiko Takeda's specialty OR field?

What is Operations Research?

Ms. Akiko Takeda, Assistant Professor, Department of Administration Engineering, Keio University Faculty of Science and Technology, remarks: "Operations Research is a scientific method to find solutions to various problems of our world, taking advantage of mathematical and statistical modeling, statistics, algorithms and the like. I especially specialize in studies on what is known as "optimization" – a method of computation for problem solving. In this method, you model a targeted actual problem in the form of an optimization problem and seek a solution for the model. And the concept of "optimization" is concerned with diverse fields of applied studies, such as business management, finance, bioinformatics and control."

Operations Research is a field of study initiated during the Second World War (see the column on page 8). After the war ended, OR has made phenomenal progress in pace with the development of computers, and is now quantitatively utilized as an effective tool for solving complex and difficult problems of our society.

"For example, OR is used to compute solutions to questions such as "How many windows should a hospital or bank provide?" and "How long will an average waiting time be if the number of windows is pre-fixed?" Aside from the main issue, it may interest you to know that the current Prime Minister Yukio Hatoyama's specialty was also OR when he was young and the theme of his doctoral thesis was 'Machinery maintenance model based on the queuing theory.' In other words, he studied the computing method as to at what point of time should machinery maintenance and repair be conducted.



Optimization being applied to diverse fields

Upon completion of her doctor's course, Ms. Takeda joined an electrical machinery manufacturer where she was assigned to a post tasked with power generation planning for an electric power company. The power company would utilize coal, oil, and natural gas-fueled generators and Ms. Takeda's task was to determine power output for each of these generators so that the company could generate electricity at the lowest possible costs. It was a highly demanding task especially as it involved future fuel price changes due to foreign exchange rate fluctuations. She added: "Satisfying electricity needs was imperative as power failure was out

of the question. At the same time I had to hold down costs while taking future fuel price fluctuations into account. However, solving the problem would become impossible if unforeseeable rapid price fluctuations had to be assumed. So it was required to set conditions within a solvable range."

"Not limited to this problem, but after actually having solved problems, in most cases you find that the answers derived via OR are close or similar to what you have been practicing by rule of thumb at your workplace. However, you can use optimization as an effective means for obtaining a consensus within your company or persuading your client because it allows you to derive answers quantitatively instead of relying on intuition or experience. In recent times the optimization method is being increasingly used as a quantitative method to justify managerial choices."

Furthermore, optimization is useful when examining and building up an investment portfolio based on an ideal combination of various financial products such as stocks, bonds, etc. It helps you to determine optimal asset allocation percentages to realize an expected level of return while minimizing risks as it allows you to combine issues prone to move according to market price fluctuations with those which are significantly less impacted by business trends.

Worthy of mention in this connection is Dr. Harry M. Markowitz who advocated a modern portfolio selection theory. He was awarded the Nobel Prize in Economic Sciences for his contribution of proposing a portfolio optimization problem known as the "Mean-Variance Model."

Much is expected of Robust Optimization

Meanwhile, optimization has its own problem. In the event of rapid stock price and/or foreign exchange fluctuations as seen in the recent economic turbulence triggered by the so-called "Lehman's Shock," investment portfolios, which were initially designed for low risk and high return by anticipating price/foreign exchange earnings ratios beforehand, often fail to match the market reality, making investors suffer significant losses. Although an optimization problem is created with the aim of building up a low-risk/high-return portfolio, it becomes extremely difficult to apply the model to market reality if one single optimization problem is to be chosen by forecasting data such as earnings ratios.

As in the previous case of the generators at the electric power company, for example, answers will vary largely depending on how you forecast fuel price fluctuations. In traditional methodologies, we defined an optimization problem by forecasting only one fuel price and derived the answer (which fuel-type generator to choose) despite the fact that fuel price is an uncertain factor. Should the forecast go wrong, reliability of the answer is lost. Against such a background, in 1998 two American research scientists, Aharon Ben-Tal and Arkadi Nemirovski, proposed what is known as the "Robust Optimization." Instead of limiting data to only one since the data may be uncertain, this method offers a permissible range that allows you to derive the best possible answer to choose from while assuming the worst situation within the given range.

"While the term 'robust' means 'strong' or 'tough,' the robust optimization may be considered a method to derive a solution resistant to fluctuations. Back to the above-mentioned power generators, robust optimization enables the worst case to be anticipated as it makes computation by allowing some latitude for values concerning fuel price and electricity demand. This helps you when you make the actual decision."

Robust optimization is also useful for optimization for tower crane operation to haul up an object. It optimizes the operation while allowing latitude for the object's weight, the length of the crane's rope and the arm's boom's angle as well as wind velocity which is an uncertain external force. Expectations are high for robust optimization as a tool that can maximize efficiency while satisfying the absolute requirement, safety.

"With robust optimization it is necessary to solve optimization problems of complex structure, but it is often the case that these problems are too difficult to obtain answers. This has given rise to a new wave of studies: "If yours is a robust optimization problem that satisfies a condition like this, then there is a way to transform it into an easier-to-handle problem". This approach aims to answer how you can transform your problem into an easier one by satisfying such-and-such conditions, or, if it's impossible, what computation method should be employed to seek a relatively better answer instead of the 'best possible' answer."

There are many themes of study for me to address. While theoretically solving these themes one by one, I would like to use the results of my work for the benefit of our society by expanding the scope of application through collaboration with research scientists from other diverse fields. Right now I'm writing a finance-related thesis, citing the robust optimization, along with one on machine learning related to bioinformatics."

While in pursuit of mathematical theories, Ms. Takeda always pays attention to the real world. From Ms. Takeda's work, I could recognize that Operations Research has unlimited potentialities and is indispensable as something that supports our modern society from behind the scenes.

(Report and text: Madoka Tainaka)

Q I'd like to invest my fund on hand in multiple issues of stocks. On what issues and how much should I invest to maximize the return one year ahead?

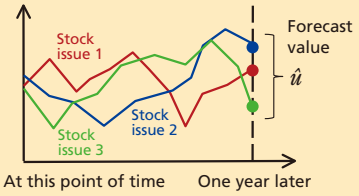
Conventional method

Seeks investment portfolio percentages that will bring the maximum return under the foreseeable situation.

$$\max_{x \in X} f(x, \hat{u})$$

Forecast and narrow down the earnings ratio into one.

Should the forecast go wrong, you may suffer a significant loss!?



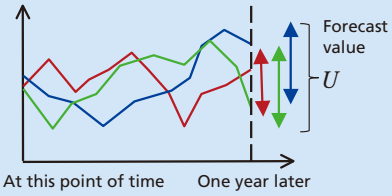
Robust optimization

Seeks investment portfolio percentages that will bring the maximum return under the worst conceivable situation.

$$\max_{x \in X} \min_{u \in U} f(x, u)$$

The worst conceivable earnings ratio is taken into account.

You'll not suffer an unreasonably heavy loss if fluctuations remain within the assumed range of earnings ratio of fluctuations.



Hoping a wide use of OR for society

Ms. Takeda is an active specialist in optimization, a field of Operations Research (OR) based on applied mathematics. However, on the contrary, she said that as a little girl she did rather poorly at school and studying was her weak point. But she used this inferiority complex to persevere in her great efforts to study and to maintain her spirit of inquiry, which paved the way for her to becoming a research scientist. However, no excitement can be seen behind her soft smiles. Instead of confining herself within the academic world, she appears always open-minded and outgoing, as she is willing to make her research results widely available to society.

Our stereotype image of a mathe - matician is an extremely sharp and wise person. May I ask if you have been good at mathematics since your school days?

To tell you the truth, I was a dropout as an elementary school girl. I made the poorest grades in school – so bad that my mother was even called to the school and was asked why. (laughter) On top of that, I was like a tomboy, running around in the school, climbing trees in the schoolyard and so forth. I was always being scolded. Therefore, any one of my old friends in the elementary school days is surprised to hear that I'm now a research scientist.

I'm truly thankful to my mother who told my teacher, "The problem about this girl is merely being slower than the other students in making progress." This remark encouraged me and made me think that I would be OK only if I work harder than the others.

I might have been the type who did not want to lose at anything. I was so strong in a desire to overcome tough subjects that during my junior and senior high school days I strove to study all the subjects thoroughly, even subjects that required learning by memorization. Frankly speaking, I had no other choice than to continue studying mathematics, even though I did not particularly love it. (laughter)

Maybe I just wanted to maintain a wide range of choice for my future. I don't mean to praise myself, but I'm rather a hard-worker.

You mean you chose a career as a mathematician in the course of events as you continued striving? You didn't have any special dream for the future or any special desire to do something?

As I recall, I didn't have any particular coveted dream to become something.

Upon graduation from high school, I joined Keio University's Faculty of Science and Technology where as a sophomore I chose the Department of Administration Engineering. In short, this department is where you study methodologies for creating and/or managing systems of society using mathematical tools. As such, targets of this learning have broad fields. Customer flow planning for supermarkets, production line planning for factories, and city planning . . . all these tasks are covered by the Department of Administration Engineering.

Speaking of myself, I had specialized in mathematical economics through the master's course. But soon I found myself increasingly intrigued by solving numerical formulas themselves. In fact, I became inclined for more mathematical studies, such as scheming out problem-solving methods and creating algorithms for packaging on computers and solving them. Under such circumstances, for the doctor's course I moved to Tokyo Institute of Technology's (TIT) Graduate School of Information Science and Engineering. I specialized in optimization, a field of operations research, and obtained the degree of Doctor of Science.

Throughout the three years of the doctor's course, I found myself absorbed in solving difficult problems. By that time I was inclined to see how my research results could be used to benefit the actual world. I was also interested in experiencing a life in the business world at least once. So, upon receiving my doctor's degree I found employment with a major electric machinery manufacturer, where I was assigned to its laboratory to engage in optimization of generators for an electric power company.

Why did you return to TIT's laboratory two years later?

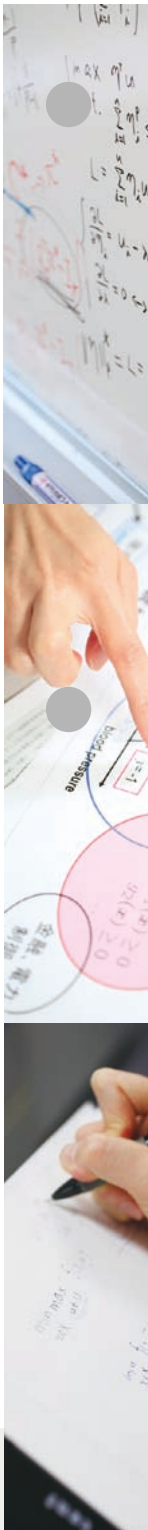
My job at the electric machinery manufacturer was exciting and fulfilling because my clients were pleased with my work and I could see my research results leading to new products or patents. There was nothing to complain about.

Just two years after I joined the company, I was told, "Would you like to apply for a post of assistant at the Tokyo Institute of Technology? This will be the last chance for you to come back to TIT as a research scientist." So I made up my mind to do so.

Until then, I had not been confident enough to be able to establish myself as a researcher. I knew I was not the genius type. I also felt that I was not suited to pursue an academic career . . . I finally made up my mind to dedicate myself to study when I left the electric machinery manufacturer to return to the university. It was rather recently, only six to seven years ago. (laughter)

Then you moved again from the TIT's laboratory to Keio University, right?

I returned to Keio two years ago. I got married around the time that I returned to the TIT's laboratory that had a fixed term of service. Since my husband works



as a research scientist for a university in Tokyo, my choice of workplace was limited to universities in the Tokyo Metropolitan area if I were to live with him under one roof. It was just about that time that Keio announced to publicly invite a researcher, for which I applied. I was more than happy when I was able to return to my alma mater, Keio.

Is your husband also engaged in studies similar to yours?

Yes, he is an OR research scientist like myself.

Right now we are working together on a joint thesis, which is in the finishing stage. We are positively stimulating each other even at home, often discussing about studies, asking for advice and so on.

It's wonderful that the husband and wife can talk about studies while understanding each other's work. By the way, what subjects are you now teaching at the university?

For sophomores and third-graders, I'm teaching OR, my specialty, in addition to mathematics. Also six seniors belong to my laboratory.

For those students eager to study for a period of three years including the master's course, I give them the latest research themes while trying to have discussions on an ongoing basis. On the other hand, for students who will end their campus life as undergraduates, I'm trying to support them in matters of their interest so that they can enjoy studies.

A student who likes playing darts, for example, is engaged in study on optimization of darts as the extension of his hobby. When it comes to a student whose hobby is playing the flute, I encourage him to use the optimization technique to restore part of a musical score that was lost in war fire.

It's possible to apply the optimization method of OR to such a diversity of areas, isn't it? Very impressive!

Yes, indeed. That makes it interesting. I always want to maintain a wide range of choice just as I did as a student when going on to the university. In other words, I don't want to limit my theories to only one application field. This is why I make it a rule to team up with people from many different fields according to research theme.

It is true that mathematics contains areas of purely theoretical pursuit regardless of whether they can serve practical purposes of our society. In my case, however, I'm not happy unless I can see how theories are put into practical use, and how they can contribute to society. Theories without concrete applications have little appeal to me.

I'd like to promote and let OR and optimization studies be better and widely known among more and more people so that they would say "Wow, I didn't know optimization was used in such-and-such a thing!"

◎ **Just a word from . . .** ◎

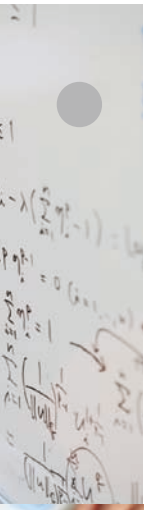
● **A student:** Ms. Takeda has a great power of concentration and often suddenly comes up with new ideas. On the other hand, she becomes almost blind to things other than the target that she is concentrating on. (laughter) She never fails to give advice whenever we ask her a question. She also always gives us new ideas one after another.

(Report and text: Madoka Tainaka)

For the full text of this interview, please refer to:

http://www.st.keio.ac.jp/kyurizukai

I challenge highly complex decision-making using a scientific approach.



Ms. AkikoTakeda

Ms. Takeda engages in the development of optimization techniques that take uncertainty factors into account. She addresses the development of algorithms for efficiently solving optimization problems in fields such as financial engineering and statistical machine learning. After obtaining the degree of Doctor of Science in 2001, she joined Toshiba Corporation' s R&D Center as a staff researcher. She then became Assistant Professor at Tokyo Institute of Technology' s Graduate School of Information Science and Engineering. From 2008 to present, she serves as Assistant Professor at Keio University' s Faculty of Science and Technology.

A day of Akiko Takeda

December 1, 2009

8:00 ～

I make it a rule to take at least 8 hours of sleep daily because insufficient sleep makes me drowsy all day and unable to do anything properly. Even so, it's hard to wake up and rise from bed whereas my husband is already up and preparing breakfast.

10:00 ～

Arrive at the campus, and check incoming e-mails.
For the past two months, discussions via e-mail are going on with the Externally Funded Project's member scientists (scientists specializing in "pure" mathematics). Exchange of e-mails regarding this project has exceeded 300. As the project title is "Search for Breakthrough by Mathematics," each one of our project members aims high to make our work a true breakthrough. As a specialist in "applied" mathematics, topics taken up in the project are often very difficult. Despite such difficulties, I'm participating in discussions via e-mail while working hard daily to catch up.

11:45 ～ 12:45

Had lunch together with my fellow instructors – a time for me to become relaxed.

12:45 ～ 14:45

I'm now in the process of writing a joint thesis with my husband. To do the numerical experiment over again, I rewrote the program by changing parameters for the mathematical model and operated the program on the PC.

14:45 ～ 16:30

Robust optimization is a research theme I'm now carrying forward with great interest. As such, I'm discussing with students hoping to make use of it for the purpose of "community creation based on recyclable energy." I entered the discussion results in the mathematical model. Pertinent data are coming in. We all look forward to this research project.

16:30 ～ 19:00

I was asked to make a presentation on the research theme of my master's thesis because it is said to be a focus of attention these days. But the problem is that I myself don't remember exactly what I verified because it's a matter of more than ten years ago. Saying to myself in anguish, "I don't understand what I did", I read my own old thesis again and prepared the material for presentation.

19:00 ～ 21:00

I met my husband after setting our meeting time at our local train station and went home together after doing some shopping. We began preparing dinner together. Not only does my husband help me in cooking (I'm not good at preparing), he even prepares our meal when I come home late. I'm thankful to my dear husband! We ate dinner while watching an American TV drama "NUMB3RS."

21:00 ～ 23:00

I discussed and confirmed with my husband the numerical experiment and verification of a theorem we conducted today, and talked about plans for tomorrow.

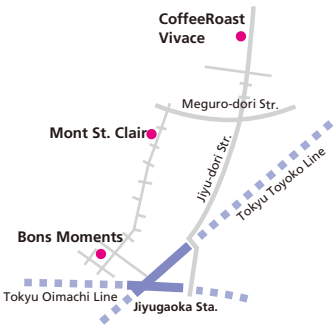
23:00 ～ 23:45

Prepared to go to bed after taking a bath.
The moment I slipped into bed, I was taken to the world of dreams . . . In my dream, I could verify the theorem in question. (← It's a jokeJust kidding! I'm not that clever.)

Strolling around the Jiyugaoka district

～ Confectioneries recommended by Ms. Takeda ～

Although there are too many of my favorite confectioneries and other shops to be written in this limited space, let me introduce only three of them as a special for this issue!



The first shop!

Bons Moments

This shop features freshly baked handmade pies. On holidays, I usually drop in at this shop to buy meat pies, which I take home, warm them in a microwave oven and enjoy with hot coffee. The pies are very delicious with their ginger flavor! Walnut pies are also my favorite.

Hours: 11:00 ～ - 19:00
Closed: Mondays and the 3rd Tuesday
A&D House 102, 2-15-10, Jiyugaoka,
Meguro-ku, Tokyo 152-0035
Tel: 03-6459-5315

These shops also recommend

Mont St. Clair

This confectionery shop is very famous in the Jiyugaoka district. It bears a Southern France image atmosphere and the shop boasts an array of over 150 items of cakes, baked sweets and chocolate. Sweets from regional areas and freshly baked bread are also some of its attractive items.
TEL：03-3718-5200

CoffeeRoast Vivace

This shop specializes in coffee beans targeting true coffee lovers. The shop-owner and his wife's rich knowledge of coffee are so fantastic that coffee beans recommended here never disappoint the customers. Even if you don't like coffee very much, you may be able to find a favorite coffee of your own here.
TEL：03-3723-3954

Ginger apple pie (¥450)
Seasonal item available only up to the end of March

私の本棚

My favorite books

Robust Optimization -In English

This is the first textbook on robust optimization, the research field I'm now most interested in. It was published only recently, in August 2009, by several authors including the author who proposed the robust optimization method in 1998. In a little over ten years since this method was first introduced, this field of study has developed so remarkably it has become a voluminous textbook like this. By reading and incorporating it, I intend to achieve significant research results in this field.

Global Optimization -In English

This book is the first imported book in English which I read to help my research pursuit in the second year of my master's course. In those days this book was not available at the Keio Library, so I borrowed it from the library of a nearby university. The book is a memorable one for me as I read it intently, carrying it around in my hand at all times. "Global Optimization" introduces a variety of methods to solve highly complex optimization problems strictly. It is often the case that attempts to express realistic problems properly in numerical formulas result in extremely difficult optimization problems. Usually some compromise is made (for example, by giving up expressing certain phenomena in numerical formulas) to simplify problems for easy solution. However, there are cases where such compromise cannot be made and problems become difficult. In such cases, the global optimization method is employed to strictly solve the problems, which is a time-consuming process. Currently studies on global optimization are not pursued widely since it targets problems that are too difficult to handle. Given the increasingly higher performance capabilities of computers, the time may come before long when these problems can be solved in a realistic period of time.

Measurement and Improvement of Operating Efficiency -In Japanese

This is a textbook on the Data Envelopment Analysis (DEA), one of the methods of operations research. It is difficult to measure operating efficiency of public enterprises such as hospitals and libraries because evaluation criteria also include factors other than "profit." The DEA method was proposed as a tool of relative evaluation, targeting business entities with a number of evaluation criteria such as "profit" and "the number of users". This method enables problem awareness to be easily understood while also allowing the problems to be formulated in an easy-to-solve manner. As an easily accessible research field, DEA can be recommended for students learning OR as a suitable theme for their graduation or master's thesis. Speaking of myself, I chose a DEA-related theme for my master's thesis. As I proceeded with the thesis, I became interested in thinking about "How to better solve formulated problems", which led to the theme of my doctor's thesis. Students, if you are in trouble looking for the theme of your graduation thesis, try reading this book. It may give you a clue!

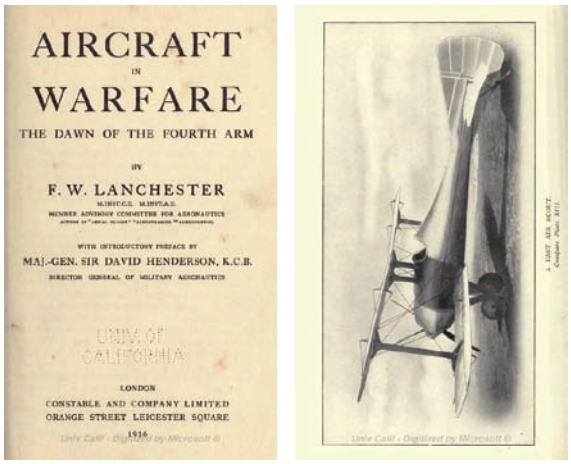
Solving Criminal Cases with Mathematics -Translated in Japanese

This book explains mathematical background for the American TV drama "NUMB3RS" (also being aired on a cable TV channel in Japan). In this drama, an FBI investigator (elder brother) and a genius mathematician/professor (younger brother) join forces to solve a number of difficult cases with mathematics playing a key role for solutions. For instance, a cash-transporting vehicle is attacked by robbers at the opening of a program. Then the genius mathematician appears to explain the shortest path problem and its algorithm. He advises saying, "If this method is applied, the robbers' escape route should be this! You should lie in ambush at this point" and impressively solves the case. In this TV drama, "mathematics" is introduced in the form of OR and statistical methods. As a viewer, I'm often impressed with the way mathematics is practically applied. While mathematical methods used in the drama are explained briefly due to time limitations, my attention tends to be attracted to numerical formulas written down on the blackboard and I wonder "Is that particular formula from such-and-such method?" In such cases I read this book for confirmation. Even when I do not view the drama, this book can be fully enjoyed as I can find that mathematical methods taught at the university can be useful in so many practical scenes.

Useful Linear Equation -In Japanese

This book is being widely advertised by Amazon and other media as "the book describing a dramatic turnaround and revival of 'integer programming' that had long been regarded useless, as a useful method." In retrospect of the past four decades, the book describes in an interesting way in which integer programming and other optimization methods have developed to this day, together with the breakthrough research works and profiles of major scientists. Prof. H. Konno, the author, is a fantastic person as he has not only written many technical books in the optimization field so far but also can write a more popular book like this that can be enjoyed by the general public. I was surprised at the book's wide range of readers when a student once approached me and wanted to join my laboratory saying, "I became interested in OR as a high school student when I happened to read Prof. Konno's book."

What is Operations Research?



The thesis published in the U.K. which marked the starting point of OR
http://www.archive.org/details/aircraftinwarfar00lancrich

The research field of Assistant Professor Takeda featured in this issue is operations research (OR). As its name indicates, OR was initially used to meet military needs."

During the World War II period, the U.S.A. and the U.K. were at fierce war against Japan and Germany and in need of methodologies for efficient and effective use of war potential capabilities, which spurred the development of OR. For instance, OR was used to identify how to operate naval ships in order to protect their own ships against the suicide attacks by Japan's kamikaze planes and how and where to install radars to effectively detect enemy planes. The basic approach of OR is not to enhance performance capabilities of individual pieces of weaponry (hardware) but to enhance efficiency in the use (software) of weaponry.

As such, OR produced remarkable achievements during the war. In the postwar period, OR came to be applied mainly to serve business purposes, such as management planning and production planning. According to the Operations Research Society of Japan website, OR is defined as "A study for problem-solving by using scientific or logical methodologies."

OR has a characteristic as being an interdisciplinary research as it encompasses not only mathematics and engineering, but also economics and business administration. Our modern society is becoming increasingly complex. Take environmental issues, for example, in which many diverse elements are intertwined. To obtain the optimal solution, OR is gaining importance more than ever.

Science and Technology Information

Strategic Management Chair for Creating Innovations (a Sony-donated chair) The 3d Open Symposium "Toward a New Phase of Development of Humankind and Society: The Future of the Global Environment and Economy"

February 24 (Wed.), 2010 18:00 ～
North Wing Hall on the Keio Mita Campus
Admission free; Prior applications required
http://www.dc01.adst.keio.ac.jp/kj/kll/index.php
This event is the last of a 3-round-series open symposium by an endowed chair established in the Keio Graduate School of Science and Technology in fiscal 2009. Mr. Mario Tokoro, President of Sony Computer Science Laboratories, Inc. and a special research fellow for Keio Graduate School of Science and Technology, will preside over the symposium, inviting Associate Professor Katsuhiro Nishinari (School of Engineering, The University of Tokyo) and other scientists for discussion.

Please apply for participation with the above URL.

The 7th KLL Industry -Academia Collaboration Seminar " - The Ever-expanding Potential of 'Light' -"

February 26 (Fri.), 2010 15:00 ～
Multipurpose classroom #3, 2nd floor, Kyosei-kan Bldg. on the Keio Hiyoshi Campus
Admission free; Prior applications required
http://www.kll. keio.ac.jp/seminar/index.html
This seminar is a seminar offered by the Keio Leading-edge Laboratory of Science and Technology (KLL). The seminar will focus on four research themes: the Nanophotonics technology that "manipulates light"; materials that are "controlled by light"; devices "based on functions of light"; and systems designed to "make use of light for medical treatment." After the seminar, there will be a meeting for friendship promotion and exchange of opinions among the seminar participants.

Please apply for participation with the above URL.

Editor's postscript

While the inaugural issue featured Assistant Professor Junichi Ushiba from the medical/engineering field, the current issue highlighted Assistant Professor Akiko Takeda from the science field. When I contacted her for an interview appointment, Ms. Takeda said, "It'll be boring to feature me because I don't move but just sit at my desk all day." But while sitting at her desk, I'm sure our readers find it exciting to see that her fields of study are actually so broad and concerned with many aspects of our society. The Takeda Laboratory was established this year. Much is expected of her laboratory.

On page 6, Ms. Takeda introduced recommended spots in the Jiyugaoka Station vicinity, only 10 minutes from the Hiyoshi Station on the Tokyu Toyoko Line which is the nearest station from our Hiyoshi Campus. In the forthcoming issues, too, we will continue to focus on "OFF time" ("bona fide" face) of the person to be featured in each issue, reporting their pursuits of personal interest and moments of relaxation during their busy daily schedules.

The next issue (Japanese version) will be published in early March, which will feature an Assistant Professor belonging to the Department of Mechanical Engineering, whose specialty being nano/micro-scale electrical machinery systems. He says he is already standing by for an interview, having put his bookshelf in order (usually in disarray). As the editor, I'm truly thankful for this consideration.

* Due to space limitation, the "New Kyurizukai" cannot carry the full text of the interview. For the full text, please refer to the website version.

(Saori Taira)

新版 窮理図解

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