IIQP NEWSLETTER

Spring 2003

Institute for Improvement in Quality and Productivity

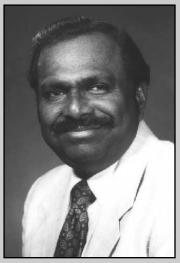
University of Waterloo

Inside...

Changing Faces

Bovas Abraham and Stefan Steiner

Bovas is the current Director of the IIQP and has been a consultant with the Institute since its inception. His main areas of interest include Quality Improvement, and the management and implementation of statistical procedures.



Bovas Abraham

Stefan Steiner is the upcoming Director at the Institute and a long standing consultant. He is currently writing a book about Statistical Engineering with Jock MacKay.

Stefan Steiner

It gives me great pleasure to introduce the new director of the Institute for Improvement in Quality and Productivity, Dr.Stefan Steiner. Stefan has been a faculty member in the Department of Statistics and Actuarial Science since January 1995. He obtained his Ph.D. in Management Science from McMaster University. He has been an active industrial consultant for the past ten years, which includes working for a consulting firm in the United States and more recently through his activities in the IIQP.

Although I will be returning to my regular position in the Department of Statistics and Actuarial Science I will still be involved in the IIQP activities. I would like to take this opportunity to thank our Corporate and University members and the Deans of the Faculty of Mathematics, Jack Kalbfleisch and Alan George for their support. I would also like to recognize the Chairs of the Department of Statistics and Actuarial Science, Steve Brown, Mary Thompson and David Matthews for their encouragement and cooperation through the years.

Bovas Abraham ◆

As of May 1st, 2003, I will become the new director of the Institute for Improvement in Quality and Productivity (IIQP) replacing Bovas Abraham who has served the IIQP ably for a number of years. Bovas returns to a regular faculty position at the University of Waterloo.

As you may be aware, this is the latest in a series of recent changes at the IIQP that included the departure of G. Dennis Beecroft and Bev Rodgers. Dennis continues his work in the area of Quality Systems, Problem Solving and Cost of Quality through his own management-consulting firm. Bev has found another administrative support position within the University. We wish them both the best of fortune.

All these changes while difficult, provide us an opportunity to rethinking the role and activities of the IIQP. As said by Ralph Waldo Emerson (1803 - 1882),

“This time, like all times, is a very good one, if we but know what to do with it.”

‘Changing Faces’, Continued on Page 2 ...

Published in the Spring, Fall and Winter, the *IIQP Newsletter* is the official newsletter of the **Institute for Improvement in Quality and Productivity (IIQP)** at the University of Waterloo. It is available free of charge.

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Letters to the Editor
We welcome your comments. The editor reserves the right to edit all submissions.

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Changing Faces *(continued ...)*

Stefan Steiner

In the coming year I will lead a review of of all the operations and activities of the IIQP including public courses, the newsletter, networking sessions, etc. If any of you feel strongly about any of these activities please let me know.

Please note that I do not envision any change to the non-profit nature of the IIQP, and we will still be providing training, consulting and research services to our corporate members, which currently include General Motors of Canada, Wescast Industries, Metal Koting Continuous Colour Coat and Research in Motion.

By way of introduction, for those of you who don't know me, I'll provide some background. I've been a professor in the Statistics and Actuarial Science department at the University of Waterloo since January 1995. My PhD is in Management Science from McMaster University. I have been an active industrial consultant for the past 10 years. This includes working for a consulting firm in the U.S, and more recently my activity through the IIQP.

I am just returning from a wonderful sabbatical year in New Zealand (a great place, I highly recommend a visit). During that time Jock MacKay and I have been busy writing a book on Statistical Engineeing that we hope will be ready for publication by the end of the year. Look for it!

Please feel free to contact me with any thoughts, concerns or questions you may have about the future direction of the IIQP. Also, we of course welcome any contact looking for help in improvement quality and/or productivity. ◆

International Conference on 'Statistics in Industry and Business'

Bovas Abraham

The IIQP together with the International Statistical Institute (based in the Netherlands) and the Cochin University of Science and Technology, Cochin, India organized an international conference in Cochin during January 1st to the 4th, 2003.

The conference provided a forum for presenting and exchanging ideas in statistical methods applicable to industry and business. It also provided an opportunity for interaction between industrial practitioners and academia. We hope that the exchange of experiences and ideas would foster international collaboration in research and other technology transfer activities.

The conference featured both invited and contributed papers in many topics of interest to industry and business, such as: Computer Experiments, Data Mining, Design of Experiments, Longitudinal Data, Multivariate Methods, Quality Systems and Management, Reliability, Robust Design, Spatial Processes, Statistical Process Control, Time Series and Warranty and Censored Data. Some case studies and expository papers were also presented.

There were about 80 participants from around the world and feeback indicated that they enjoyed the conference immensely.

We are hoping to publish a special volume of the international journal 'Statistical Methods' with papers based on those presented in the conference.

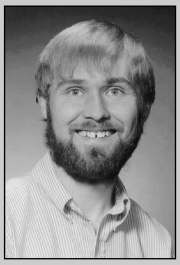
The conference also received a lot of attention through the local newspapers.

Overall the conference was a great success. ◆

Functional Data Analysis

Hugh Chipman

Hugh Chipman is an Assistant Professor in the Department of Statistics and Actuarial Science at the University of Waterloo. His research interests include Data Mining and Quality Improvement.



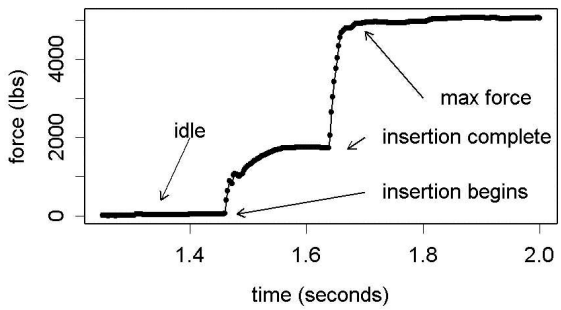
Hugh Chipman

What do a patient's vital signs, an assembly step in a manufacturing process, and a digitized image of a finished part have in common? They all give rise to functional data, which come in the form of curves or functions rather than the numbers which are considered in conventional statistics.

This kind of data is becoming more prevalent: automated measuring systems make data collection easy. Unfortunately, much of the richness of functional data is often ignored, and only a few coarse summaries such as a maximum, minimum, or mean of the curve may be kept. This article should give you a flavour of ways to make fuller use of functional data.

Here's a example. In a production process, a sleeve is force-fitted by a ram into a cylindrical tube. The sleeve is held in place by a tight fit alone, so a proper insertion is critical. To monitor the quality of each insertion, the insertion force is automatically measured every 1/400th of a second, yielding a force-time curve pictured in Figure 1. Several events are labeled: on the left ('idle'), nothing has happened yet; the sleeve has not yet contacted the tube. When insertion begins, force increases in response to insertion friction. Once insertion is complete, force increases substantially, since the system continues to attempt to insert the sleeve. In addition to having physical significance, 'landmark points' such as these will be useful in processing curves.

Figure 1

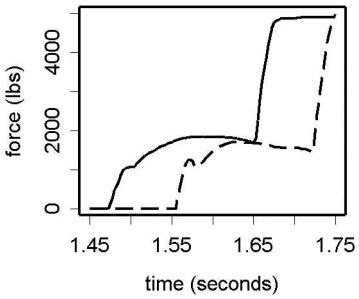


Remember that a curve like this corresponds to a single part. Thousands of such parts are manufactured, yielding a very large volume of data. The curves can give clues about the process: Which insertions were faulty? Is the machine that does the insertions deteriorating or drifting over time?

Before such questions can be addressed, some straightforward preprocessing steps are necessary. In Figure 2, two curves from two different insertions are plotted. While they have common features, the curves are not aligned. The second insertion (dashed curve) began nearly 1/10th of a second later, and happened slightly faster (the dashed line has a shorter horizontal distance between minimum and maximum points). The landmarks mentioned earlier can be used to align the curves (Figure 3). The start of the insertions are shifted to time 0, and the horizontal axis is stretched so that the 'insertion complete' points coincide. The values used to line up each curve (a shift constant and a stretch constant) would be saved, in case they represent valuable information about the individual curves. In practice, hundreds or thousands of curves would be aligned in this manner.

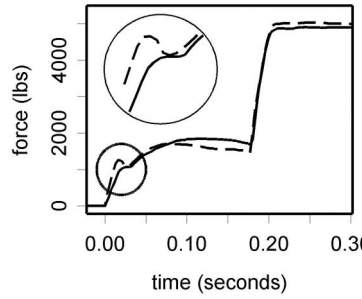
Once the curves are aligned, direct comparisons are possible. In Figure 3, the circled region (enlarged to show detail) indicates that one curve has wiggled more near the start of the insertion. Could this be a clue as to some difference in the insertion process for the two parts? If the engineers felt that this region of the curve was important, automatic methods could sound an alert if certain shapes occurred.

Figure 2



A more general question is whether such features could be automatically extracted from a set of curves. That is, given a large set of aligned curves, can statistical models be used to automatically identify the shape characteristics that vary most between the curves? Such modelling might lead to new ways to examine the curves. In this particular example, some such modelling has been carried out, and the two main modes of variation appear to be in the

Figure 3



'Functional Data Analysis', Continued on Page 4 ...

Functional Data Analysis *(continued ...)*

Hugh Chipman

wiggle near the start of the curve (already identified) and in the long, gradually curved part near the middle of the curve. These curve 'features' can be though of as a few numbers extracted from the the curve. Once such extraction has been carried out, subsequent statistical analysis can be carried out on the features, such as control charting.

The part insertion problem is just one example of functional data analysis. Many different applications give rise to curves as data, and a suite of analysis tools can be applied, after appropriate alignment and preprocessing. Depending on the type of problem and data available, different analyses are possible. For example, suppose we wish to predict some outcome for each object, and observe both a curve and the outcome for some cases. We identify relevant features of the curve, and use these features to build a predictive model. Other, less structured goals are possible, such as monitoring different curve features over time to identify problems with the process, or grouping together curves according to their shape.

Functional data can come in a variety of forms. Here, we had points on a single curve, but it is also possible to have points on a surface. An example would be an image, which can be viewed as a function of two variables (the horizontal and vertical coordinates of each pixel, with the color and/or brightness being the function). Such richness of data can enable a wide range of useful and informative analysis techniques. ◆

Recent Presentations

What is Statistical Method?
University of Auckland
Auckland, New Zealand August 2002 J. MacKay
CSIRO
Melbourne, VIC, Australia November 2002 J. MacKay

Variation Transmission
Waikato University
Hamilton, New Zealand August 2002 J. MacKay

Statistical Method
Western Australian Statistical Association
Perth, WA, Australia October 2002 J. MacKay

Modelling and Analysis of Duration Data from Longitudinal Surveys
Statistics Canada Symposium 2002
Ottawa, ON, Canada November 2002 J. Lawless

Quality Improvement Through Statistical Thinking
McMaster University
Hamilton, ON, Canada November 2002 B. Abraham

Regression Tools for Health Research Workers
Doctoral Programs in Public Health, University of Helsinki
Helsinki, Finland December 2002 D.E. Matthews

Quality Improvement and Statistical Thinking
International Conference on Statistics in Industry and Business
Cochin, India January 2003 B. Abraham

Estimation of State Occupancy Probabilities with Application to Quality of Life and Culumative Costs
University of Montreal
Montreal, QC, Canada January 2003 J. Lawless

Statistics and Society
Cochin University of Science and Technology
Cochin, India January 2003 B. Abraham

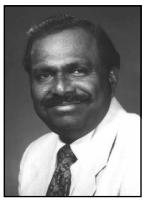
Estimating Functions and Pseudolikelihood
Medical Research Council Biostatistics Unit
Cambridge, England February 2003 J. Lawless

Assessment of Treatment Effects with Recurrent Event Responses
Biometric Society Eastern North American Spring Conference
Tampa, FL, USA March 2003 J. Lawless

Bayesian Additive Regression Trees
York University
Toronto, ON, Canada March 2003 H. Chipman

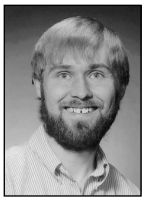
Upcoming Courses

Our Course Instructors ....



Bovas Abraham
Director, IIQP

Cliff Blake
Management Sciences, UW



Hugh Chipman
Consultant, IIQP

Chris Fader
Economics, UW

Jock MacKay
Consultant, IIQP

Stefan Steiner
Consultant, IIQP

Advanced Data Mining

ONE DAY COURSE

Course Description

More and more companies have enormous databases which may contain undiscovered but useful information. Data Mining is the search for this information using statistical models and computational techniques. This one day course will illustrate the state of the art, using real data from direct marketing, drug discovery and industrial control problems.

You Will Learn

- What is Data Mining?
- Methods for Preprocessing Data
- Graphical Exploration of Data
- Classification and Regression Techniques
- Clustering

Applications in the Course Include

- Direct Marketing
- Drug Discovery
- Process Monitoring with High Dimensional, High-Volume Data

Course Date

October 3, 2003

Cost

$395 (+GST)

Cost Includes: tuition, course notes, handouts, lunch, coffee and refreshments.

Design of Experiments

TWO DAY COURSE

Course Description

A designed experiment is a special type of process study that involves changing one or more process characteristics to investigate their effects.

Design of Experiments (DOE) is one of the continuous improvement tools in Six Sigma and ISO 9001:2000. This two day course will teach you how to effectively use this key methodology to improve quality and reduce costs.

This course will provide you with the right tools to understand, plan and execute an experiment. You will also gain the experience in deciding if experimentation is a good approach to your particular problem(s).

You Will Learn

- What is an Experiment?
- Experiments vs. Other Data Based Approaches
- Complete Factorial Experiments - looking at several factors simultaneously
- Fractional Factorial Designs - efficient ways to look at many factors
- Taguchi's Robust Designs to Reduce Variation
- Implementation - Planning and Executing Experiments

Course Dates

November 6-7, 2003
May 29-30, 2003

Cost

$790 (+GST)

Cost Includes: tuition, course notes, handouts, lunches, coffee and refreshments.

Forecasting in Quality / Productivity Improvement

TWO DAY COURSE

Course Description

Forecasting plays a central role in business decision making: decisions about investments, resource allocations, schedules and inventory levels. This course gives an overview of useful quantitative forecasting tools and it also covers regression/time series models that incorporate into the forecasts any additional information such as sales promotions and price reductions. Computer software implementing these procedures are demonstrated, and participants have the opportunity to practice their new skills with their own data sets.

Course Contents

- Sales Forecasting and Inventory Control
- Quantitative and Qualitative Forecast Approaches
- Exponential Smoothing Forecast Procedures
- Autoregressive Models for Forecasting
- Forecast Models for Incorporating the Effects of Promotions
- Forecast Evaluation and Forecast Tracking
- Case Studies
- Discussion of Computer Software
- Hands-on Computer Lab to Practice New Skills

Target Audience

- People in Marketing, Operations Management, Logistics and Inventory Control
- Brand Managers

Course Date

October 30-31, 2003

Cost

$790 (+GST)

Cost Includes: tuition, course notes, handouts, lunches, coffee and refreshments.

Knowledge Management

ONE DAY COURSE

Course Description

Firms today are experiencing acute competitive pressures for a variety of reasons. Successful firms are employing better organizational design and improved management techniques in order to improve performance. It is these firms that recognize that the creation, retention and application of knowledge are now key competitive success factors. This growing awareness of the value of specialized knowledge and the awareness of knowledge as a distinct factor of production has led to a new field of study and practice - knowledge management. This one-day course will introduce the fundamentals of knowledge management.

You Will Learn

Defining Knowledge Management

- Information vs. Knowledge
- Key Concepts

Explicit and Implicit Organizational Knowledge

- Problems of Knowledge Codification and Coordination
- Mapping and Modeling Knowledge
- Capturing Tacit Knowledge
- Knowledge Transfer

Technologies for Knowledge Management

Practicing Knowledge Management

- Case Studies of KM (Successes and Failures)

Course Date

October 17, 2003

Cost

$395 (+GST)

Cost Includes: tuition, course notes, handouts, lunch, coffee and refreshments.

Managing for the Future

TWO DAY COURSE

Course Description

We are in an era of organizational transformation, when new forms of enterprise are emerging, and old forms are changing radically. It is essential that high potential leaders understand these changes and be able to take effective action in the organizations of today and tomorrow. As a result of the growing recognition of the difficulty to shift to the new organizational forms, and the challenges encountered in taking action in the new work context, an introduction to some of the required individual skills and organizational features are developed in this course

You Will Learn

- Key Features of Emerging Organization Models
- The Major Drivers Behind Development of New Models
- Assessment of Organizational Change from Traditional Models to New Models
- Individual Skills and Organizational Features Required by the New Model
- Power and Conflict in Traditional and In New Organizations

Who Should Attend

- Human Resources Personnel
- Training Professionals
- Management Leaders
- Quality Professionals

Course Date

October 23-24, 2003

Cost

$790 (+GST)

Cost Includes: tuition, course notes, handouts, lunches, coffee and refreshments.

Statistical Engineering

TWO DAY COURSE

Course Description

Statistical Engineering is a combination of statistical strategies and tools carefully selected to efficiently solve chronic problems in high volume manufacturing. Statistical Engineering attempts to exploit observational data from your existing process to “home in” on the root cause of problems.

This two day course covers the guiding strategies and tools you need to effectively apply this exciting methodology to improve quality and reduce costs. This course is a requirement for our new Statistical Engineering certification program, and is also a good compliment to the Design of Experiments two day course.

You Will Learn

- Guiding Principles of Statistical Engineering
- Structured Problem Solving Strategy - diagnostic and remedial journeys
- Progressive Search and Families of Variation
- Clue Generation Methods - using observational data to efficiently guide improvement efforts

Course Dates

June 19-20, 2003
November 20-21, 2003

Cost

$790 (+GST)

Cost Includes: tuition, course notes, handouts, lunches, coffee and refreshments.

How Do I Register?

ONE DAY COURSE

You may register online or contact the Institute at the address below.

IIQP
200 University Ave. W.
University of Waterloo
Waterloo, Ontario N2L 3G1
Tel. (519) 888-4593 Fax. (519) 746-5524
Web. http://www.iiqp.uwaterloo.ca/Courses

More Information

- All IIQP courses can be tailored to suit specific needs or applications and presented within your company. Such courses are often developed by modifying or combining existing courses, depending on the request.
- Instructors are University of Waterloo faculty and IIQP staff who are professionals with extensive industrial training and consulting experience.
- Refund of fees will be made only if notice of cancellation is received at least 10 working days prior to the start of the course. Substitution of participants from the same organization is permitted.
- Please add GST to all course fees (GST#: R119 2606 85)

Name: _____

Position/Company: _____

Address: _____

City: _____

Postal Code: Zip: _____

Tel: _____

Fax:_____

E-Mail:_____

Please Specifiy Course(s) and Date(s):

_____

☐ Bill to PO # _____ ☐ ChequeEnclosed

Scatterplots - A Useful Tool

Jock MacKay

Jock MacKay is the former Director of the Institute and a long standing consultant. He is currently writing a book about Statistical Engineering with Stefan Steiner, the new Director.

Jock MacKay

A scatterplot is a basic quality tool. It surprizes me how poorly we understand and underutilize this powerful plot. In high school, most of us were introduced to the idea of plotting points on a grid (formally called the Cartesian coordinate system). Somehow we lose our early comprehension of creating and interpreting these plots.

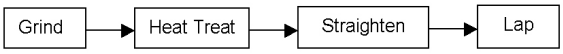
We can construct a scatteplot from data on a set of parts or units where there are values for two variables.

Example 1 - Suppose we have two measurement systems to determine the hardness of a casting. We take a set of 30 castings and measure the hardness on each system. In the language of scatterplots, we have 30 points to plot, one for each casting. We can make the plot using the menu Chart > XY(scatter) in EXCEL. The plot is in Figure 1.

Figure 1

Each diamond on the plot corresponds to the pair of measurements on one casting. The coordinates of the labeled point give the first and second measurements for that casting.

Figure 2

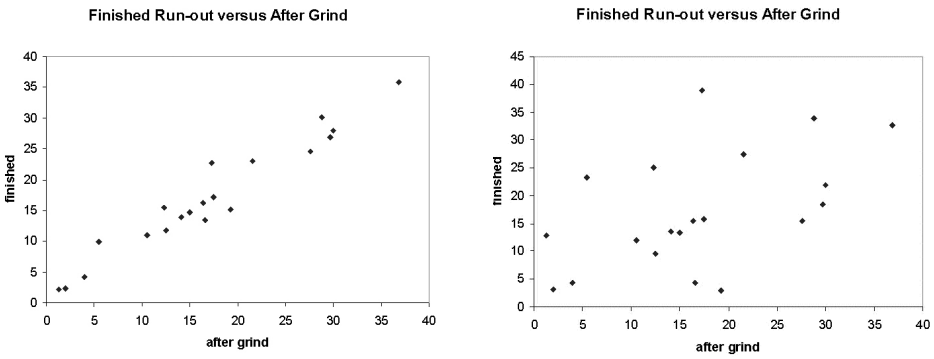


From the plot, we can see that castings with larger values on the first measurement system give larger values on the second (a good thing!). The two measured values for a casting are close to each other (another good thing!). Finally, we see that the second measurements are uniformly larger than the first (a bad thing) [this statement is equivalent to all plotted points being above the diagonal joining the bottom left to the top right corner of the plot].

Example 2 - A machining process has several steps. See Figure 2.

Suppose we measure the run-out of a diameter on the same 20 parts after the grinding and again after the lapping operation. We can use a scatterplot (each point corresponds to the two run-out measurements on a single part) to portray the data. Two possible plots are shown in Figure 3. What do they tell us about the process?

Figure 3



From either plot, both the after-grind and finished run-out varies from near 0 to about 40 microns. On the left hand plot, we can see that the final run-out is close to the after-grind run-out (as in the comparison of two measurement systems). In the right hand plot, there is little relationship between the two measurements. Parts with after-grind run-out in the range 15 to 20 have final run-out varying from 0 to 40 microns, the full range of variation.

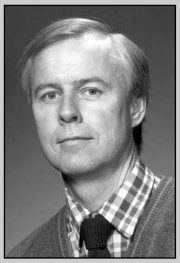
The left-hand plot tells us that the variation in the final run-out is due to variation coming from the grinding operation. The rest of the process faithfully transmits this variation to the end. There is little value in working on the heat treatment, straightener or lapper if you want to reduce variation in run-out. The right-hand plot tells the opposite story. None of the variation in final run-out is coming from the grinders. The variation is added downstream. There is a variety of other pictures all of which tell us something about the source of variation in final run-out.

I selected these two examples to convince you that with the right data and a scatterplot, you can learn facts about a process, not easily discoverd with any other approach. ◆

Statistical Science - Tools for Learning and Action

Jerry Lawless

Jerry Lawless is a professor of Statistics and Actuarial Science and the GM/NSERC Industrial Chair at the University of Waterloo.



Jerry Lawless

Statistical methods are very widely used in a huge number of fields. Historically, statistics is closely linked to the scientific method, with emphasis on principles of good design and analysis of studies. As such, it is associated with "learning" about populations and processes. The British statistician D.J. Bartholomew has remarked that "statistics is concerned with understanding the real world through the information we derive from classification and measurement", and that "its distinctive characteristic is that it deals with variability and uncertainty which is everywhere". Advances in measurement, computing, and information technology have had a profound effect, but the statistical principles of experimental design, sampling, observation, and analysis that were developed in the early years of the 20th century remain valid today. In the fields of quality and productivity, such tools were developed to great and lasting effect by familiar names like Shewhart, Deming, Box, and Taguchi.

Today, many statistical applications are primarily technological rather than scientific: automatic process control; the selection of individuals from large data bases for direct marketing campaigns; the identification of individuals from biometric profile measurements. A characteristic of such activity is that input data is used to make decisions. For example, on the basis of an optical scan of a person's thumb, security software must identify the person and check whether they have clearance to enter a secure area. Technological work is carried out under severe time constraints; many decisions must effectively be made immediately upon receipt of the data, so implementation in efficient software and hardware is essential.

The two aspects of statistics, as scientific methodology and as a set of tools for "action", have been evident for a long time, but this has been slowly recognized in statistics teaching. However, university and college graduates are more often engaged in technological than in scientific work, and their statistical training should reflect this. In addition to traditional topics such as experimental design, sampling, statistical inference, and model fitting, students need to learn about decision or action problems. Methods based on statistical models along with approaches from other fields should be introduced. For example, the field of machine learning in computer science often deals with classification and decision problems through algorithms that operate on input data, without relying much on standard statistical models. Terminology in these areas can differ from that in statistics: in computer science, data used to fit a model or develop an algorithm are often referred to as "training" data, and what statisticians term variable selection is often called feature selection.

As an example, consider the automatic (machine) recognition of handwritten digits. This typically involves a scanning device from which a numerical representation is obtained; for the sake of discussion suppose these numerical data are grey scale values for each of the pixels in a rectangular grid. The "decision" problem is to use the data from a particular scan to decide what digit a person has written. A statistician might approach the problem by forming a model for the probabilities of different digits, given the numerical grey scale measurements. If a good model can be found, we set up software so that when presented with data on a written digit, it "decides" that the digit is that which has the highest probability, given the pixel grey scale data. On the other hand, a computer scientist's first line of attack might be to define a similarity function that measures the closeness of two sets of pixel grey scale data, and to build up a "library" of written digits. When presented with a written digit, the software computes the closeness of its pixel grey scale data to that for each digit in the library, and classifies the digit according to which library member it is closest to. Such "nearest neighbour" approaches with cleverly chosen similarity functions have been able to achieve up to 98% correct classification.

In fact, statisticians, computer scientists, and others are becoming more familiar with each other's approaches, and much combining of methods is taking place. There are fortunately also signs of increased emphasis on technological problems and decision making in some statistics programs. Topics such as process monitoring and control have been taught for many years at University of Waterloo, and tools such as classification and pattern recognition are included in undergraduate and graduate courses. There are undergraduate option packages involving engineering and statistics, and a joint Masters program in computer science and statistics. In addition, institutes such as the IIQP offer short courses such as Advanced Data Mining and Forecasting, in which classification and decision problems are studied. My hope for the future is that statistics teaching, or as I prefer to call it, statistical science teaching, will continue to stress the scientific concepts and principles that the discipline is based on, while at the same time giving decision methodology and technological applications more prominence. Statistical science provides tools for both learning and action, and that should guide the modern curriculum. ◆

Corporate Membership

Jennifer Gaunt

The Institute for Improvement in Quality and Productivity (IIQP) at the University of Waterloo was established in 1985 as a centre to promote quality and productivity improvement in all of its many aspects.

The role of the Institute is to encourage the flow of knowledge, ideas, methods and problems between the university and business communities to their mutual benefit. Over the last decade, within the university there have been many changes to course curriculum, teaching methods and research programs because of faculty and student involvement in the IIQP and their exposure to real world quality problems. A large number of business organizations can attribute bottom line improvement to the knowledge acquired through association with the Institute.

The Institute is a non-profit organization. Revenues are generated by teaching and consulting activity, corporate memberships and research grants. Excess revenues are used for promotional and research activity.

Any individual or corporation is welcome to make use of the services offered by the IIQP. In addition, corporations are encouraged to consider becoming a "corporate member" or sponsor of the Institute. Such a sponsorship entitles the corporation to special rights and responsibilities with the IIQP, such as reduced rates for our consulting/training seminars, R&D tax benefits, membership on the IIQP Board of Directors, and additional opportunities for interaction and influence on the long-term goals of the Institute.

Corporate Membership Categories

Partner - Companies with more than 300 employees.
Associate - Single plant/facilities of larger companies who wish to be members without total corporate commitment
Affiliate - Companies with less than 300 employees.

For more information, please contact us:

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