ASQ STATISTICS DIVISION Newsletter©

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Chair's Message

by Gordon Clark

This message reports three significant events that will occur since our last newsletter. That is, we will have a new special publication, we have improved the Division hosted discussion boards on the ASQ server, and we will have a hospitality event at the coming WCQI.

Special Publication

William Rodebaugh, our Special Publication Chair, is working to produce a Special Publication at the time of the WCQI in early May. This special publication will include two papers: *Business Improvement Methods – What's on the Horizon?* by Ron Snee *and Fall Technical Conference Keynote (A Look Back and a Look Ahead)* by Stu Hunter. We will mail paper copies of this publication to each member. In addition, new members joining after May will automatically receive a paper copy.

Statistics Division members can receive electronic copies of previous special publications by accessing the Members Only section of our Web site, www.asqstatdiv.org. Go to the Home Page and click on "Members Only" under *Quick Links*.

Statistics Division Discussion Boards

The division hosts discussion boards on the ASQ server (URL: www.asq.org/discussionBoards/). Those discussion boards get much more usage than the discussion boards on our Web site. Thus, we decided to support the ASQ server discussion boards by appointing moderators. In addition, we changed the scope of the Process Capability Discussion Board to Statistical Process Control. The following table lists the ASQ server discussion board names and their associated moderators:

Discussion Board	Moderator
Designed Experiments	James Lucas
Six Sigma	Jonathan Andell
Statistical Process Controls	Gordon Clark
Statistics	Timothy Folkerts

The four discussion boards shown in the table serve both Statistics Division and ASQ members not in our Division. The Designed Experiments, Six Sigma and Statistical Process Control boards had moderators as of February 22, but the Statistics Board moderator did not start until after April 1. During 2007, the number of postings increased dramatically after we assigned moderators to the Designed Experiments, Six Sigma and Statistical Process Control boards. The number of daily postings increased from 0.5 to 1.72 per day (from 2/22 through 4/01/06). Increasing the scope of the Process Capability Board to Statistical Process Control is also a contributing factor. During 2007, these four discussion boards had 80 postings by Statistics Division members, as well as 66 postings by ASQ members not in our Division.

The discussion boards on our www.asqstatdiv.org Web site, corresponding to the four boards appearing above, did not have a single posting during 2007. A factor contributing to this result may be the visibility of the ASQ server discussion boards once a Statistics Division member logs onto www.asq.org.

We encourage Statistics Division members to visit and try our discussion boards. One can obtain helpful information at no cost by using these discussion boards. The boards exist to answer both introductory and advanced questions.

WCQI Hospitality Event

All Statistics Division members attending the WCQI are invited to attend our hospitality event just prior to the council meeting. We will have pizza and drinks from 6:00 to 7:00 PM on Monday, April 30 in Salon 14. Come and meet the Leadership Committee and hear our plans for the coming year. You are also invited to attend the council meeting, which is scheduled for 7:00 PM in the same room.

Inside This Issue

VISION

- Data Driven Decisions Through Statistical Thinking
- We are the recognized forum that advances data-driven decision making through Statistical Thinking.

MISSION

- Advance data-driven decision making through Statistical Thinking.
- Improve the public's perception and understanding of statistical methods and data-driven decisions.
- Be the source for the statistical components of the ASQ body of knowledge.
- Support the growth and development of ASQ Statistics Division members.
- Increase the credibility, marketability and influence of ASQ Statistics Division members.

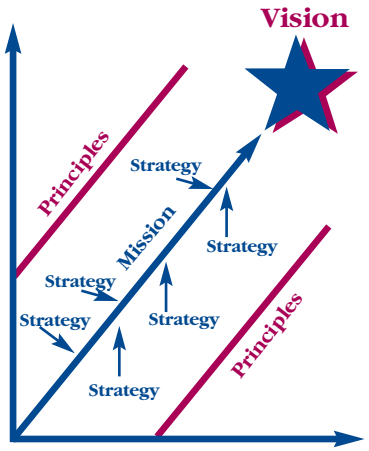
STRATEGIC FOCUS

1. BODY OF KNOWLEDGE
   - What it is?
   - Where is it?
   - How to categorize it?
   - Disseminate via Web page
   - Keep current
   - Partner with HQ
   - Goals to understand, organize, make accessible, inventory, gap analysis

2. COMMUNICATION
   - Newsletter
   - E-Zines
   - Align both to vision and mission
   - Gap analysis with primary audiences
   - Discussion boards
   - Promote via E-Zine, conference booths
   - Align discussion boards to vision and mission
   - Evaluate whether to continue

3. VOICE OF THE CUSTOMER
   - Members, other divisions, audiences
   - Proactive way to engage (go, see listen)

4. DATA DRIVEN DECISIONS
   - How do we advance?
   - Do we broaden the audience?
   - AQC session?
   - Partnerships?



DESIRED END STATE

- Our members will be proud to be part of the Statistics Division.
- Our Division's operations will be a model for other organizations.
- We will be a widely influential authority on scientific approaches to quality and productivity improvement.

PRINCIPLES

- Our customers' needs will be continuously anticipated and met (i.e. Customer focused rather than customer driven).
- Our market focus for products and services is weighted as follows:
  - Greatest weight on intermediate level.
  - Nearly as much weight on basic level.
  - Much less weight on advanced level.
- Focus on a few key things.
- Balance short-term and long-term efforts.
- Value diversity (including geographical and occupational) of our membership.
- Be proactive.
- Recognize that we exist for our customers.
- View statistics from the broad perspective of quality management.
- Apply Statistical Thinking ourselves; that is, practice what we preach.
- Uphold professional ethics.
- Continuously improve.

MEETING GROUND RULES

- Respect and listen to all participants.
- No speeches.
- No "side-bar" discussions.
- Decisions by consensus, if possible.
- We will be open and honest, even if it hurts.
- Support your ideas, don't defend them.
- We will delegate word-smithing to small groups.
- All help facilitate, although we will have a formal leader, facilitator, scribe, and timekeeper (including at breakouts).
- We will rotate scribes.
- We will keep a separate flipchart for To-Do's.
- Mission, Vision, Principles, Strategy, Ground Rules should be visible.

Disclaimer

Criteria for Basic Tools and Mini-Paper Columns

Basic Tools

Purpose: To inform/teach the "quality practitioner" about useful techniques that can be easily understood, applied and explained to others.

Criteria:
1. Application oriented/not theory
2. Non-technical in nature
3. Techniques that can be understood and applied by non-statisticians.
4. Approximately three to five pages or less in length (8 1/2" x 11" typewritten, single spaced.)
5. Should be presented in "how to use it" fashion.
6. Should include applicable examples.

Possible Topics:
New SPC techniques
Graphical techniques
Statistical thinking principles
"Rehash" established methods

Mini-Paper

Purpose: To provide insight into application-oriented techniques of significant value to quality professionals.

Criteria:
1. Application oriented.
2. More technical than Basic Tools, but contains no mathematical derivations.
3. Focus is on insight into why a technique is of value.
4. Approximately six to eight pages or less in length (8 1/2" x 11" typewritten, single spaced.)
   Longer articles may be submitted and published in two parts.
5. Not overly controversial.
6. Should include applicable examples.

General Information

Authors should have a conceptual understanding of the topic and should be willing to answer questions relating to the article through the newsletter. Authors do not have to be members of the Statistics Division.

Submissions may be made at any time to the Statistics Division Newsletter Editor. All articles will be reviewed. The editor reserves discretionary right in determination of which articles are published.

Acceptance of articles does not imply any agreement that a given article will be published.

Editor's Corner

by Brian Sersion

Welcome to the WCQI edition of the ASQ Statistics Division Newsletter. The Division has decided to offer a hard copy of this issue to members attending the annual conference. If there is a favorable response to this offering, we may establish an annual printing of the Spring Newsletter. The idea arose from my previous experience at the Fall Technical Conference (FTC). A few years ago, I brought 20 color copies of our newsletter to the FTC meeting and set them out for members. By the following morning, all of the newsletters were taken. Although the electronic version has many advantages (e.g. distribution simplicity, direct Web links to information, lower cost, etc.), no one can doubt that sometimes having a hard copy is best. So we hope you enjoy reading the newsletter while on your way home from Orlando, Florida. A related issue is a concern that I have for Division members that are not receiving the newsletter in the format they desire. It was never our intention to exclude people from receiving the newsletter when we stopped mailing it to members. With this in mind, I am working on developing a system to ensure that all members that want a copy of the newsletter receive one. I'm not sure now what form this may take, but we will be discussing this issue in the future.

A few features of this newsletter include a timely Mini-Paper by Jonathon Andell, entitled *Data-Driven Decision Making and Organizational Excellence* and the reprint of a great article by Christine Anderson-Cook, entitled *Different Roads to take for Data Analysis*. Hopefully, you will have an opportunity to meet Jonathon at this year's World Conference on Quality and Improvement (WCQI). He is currently serving on the Leadership Committee as Membership Chair and I expect he will be making an appearance at the WCQI Statistics Division booth. The paper by Ms. Anderson-Cook was originally published in Quality Progress, October 2006 (pgs 75-76, Statistics Roundtable). This article revisits the discussion of Classical versus Bayesian analysis methods. I recall encountering this topic during my graduate studies and really enjoyed her straightforward and succinct treatment of the subject.

Please remember to contact me if you have any comments or suggestions on the newsletter (e-mail: sersiob@cps-k12.org). I wish everyone a safe trip home wherever your travel may take you on this day or any other day. See you next Fall.

Statistics Division Narrated Slide Shows

The Statistics Division is in the process of developing Narrated Slide Shows as an approach to presenting Quality Body of Knowledge (Q-BoK) topics in statistics. Scott Kowalski is the Statistics Division leader responsible for developing these slide shows, and he presented a brief example of a slide show at the DAC/SAC meeting in November 2006. Scott is developing the following eight modules:

- Basic Statistics
- Regression Analysis
- Analysis of Variance (ANOVA)
- Gage R&R (Repeatability and Reproducibility)
- Statistical Process Control (SPC)
- Capability Analysis
- Design of Experiments (DOE), and
- Soft Six Sigma Tools

A module consists of several presentations on a similar theme. Each narrated presentation within a module is approximately 20 minutes long and focuses on a particular statistical tool or concept. The presentations are viewed using a Web browser and each slide in the presentation has stop/pause/rewind/forward buttons. This enables the person viewing to go through the presentation at their own pace.

The Basic Statistics and Gage R&R modules are complete. Scott is the author of the Basic Statistics module, and Dr. Connie Borror is the author of the Gage R&R slide shows. Members can download these modules from our www.asqstatdiv.org Web site. The cost is $5 for a slide show or $20 for an entire module (1 slide show for free). The slide shows contained in each module are as follows:

Basic Statistics Module	**Gage R&R Module**
Tests for a Single Mean	Introduction to Gage R&R Studies
Two Sample t-test	Gage R&R for Crossed Designs
Paired t-test	Gage R&R for Nested Designs
Proportion Tests	Measurement System Analysis: Bias and Linearity
Power and Sample Size	Gage R&R for Attribute Data

In addition, there are 2 free narrated slide shows; one is on the basics of hypothesis testing and the other is an invited talk given at the 2005 Fall Technical Conference. The Statistics Division plans to add more free presentations on statistical thinking and some talks from the 2007 WCQI.

The presentations help the viewer gain a thorough understanding of how and where the statistical tool is applied. By enlisting subject matter experts, the Statistics Division believes these presentations provide an excellent use of technology to disseminate the Q-BoK. Go to the following URL to learn more http://www.asqstatdiv.org/narrated.htm

MINI PAPER

Data-Driven Decision Making and Organizational Excellence

by Jonathon L. Andell

"...when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind..." – Lord Kevin

This paper discusses how statistical thinking provides a conceptual framework for customer-centered process management. In particular, we consider how a key aspect of statistical thinking, namely data-driven decision making, provides a practical analytical basis for acquiring data, analyzing it, and using the results to make sound, process-related decisions.

Many key points are presented in terms of failure to take advantage of the opportunities presented, for two reasons: 1) because discussion of missed opportunities actually is more straightforward, and 2) because missed opportunities are so abundant in actual practice. To those readers already aware of these opportunities, apologies are offered in advance.

Statistical Thinking and Data-Driven Decision Making

In a *Special Publication of the American Society for Quality's Statistics Division (ASQStatDiv)*[1], Britz et. al. provide the following principles of statistical thinking:

1. All work is done in a series of interconnected processes
2. All processes vary
3. Understanding and reducing variation are keys to success

The first principle reflects what Deming used to call "systems thinking." Not only must we recognize that processes are interconnected, but they are in fact interdependent, often in ways not obvious on the surface.

Consider for example the hotel in which room service breakfasts were arriving late and therefore were free – that is, the hotel was losing revenue. Process data quickly confirmed that meal preparation time was acceptable. Analysis eventually revealed that the housekeeping staff was clogging elevator traffic, transferring towels and linens among floors. It turns out that a well-intended individual had reduced inventories of cloth goods to lower costs. Without systems thinking, there was no way to anticipate that the small savings in inventory would be more than offset by a substantial loss in revenue.

The second principle admonishes us to see beyond mere averages. The unhappy customer experiences not the mean, but rather the serious departure from average. This leads us to the third principle: before we can understand why the departures from average happen, we need to know how often those departures occur, and how far those departures actually stray from average. Of course, such knowledge is what some people call "necessary, but not sufficient." The missing link is a collection of tools for analyzing data in such a way as to extract process knowledge from the numbers.

We call that missing link "data-driven decision making." Figure 1 is a model of how statistical thinking, statistical methods, and data-driven decision making go hand in hand. Statistical thinking ensures that we seek data that describes how process variation affects customers. Statistical methods give us the power to extract knowledge from the data. Data-driven decision making enables us to turn that knowledge into appropriate decisions for the good of our customers, and ultimately for the organization's benefit.

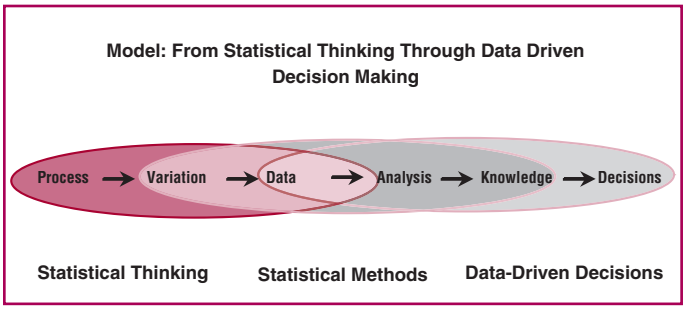


Figure 1

Observe that the existence of data is common to all three major elements: statistical thinking, statistical methods, and data-driven decisions. However, as the next part of this discussion will point out, not just any data will achieve the intended outcomes.

Obtaining Dependable Process Data

Let us define "good data" as providing accurate and objective measures of how well the process serves its customers. Almost all seem

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to agree that good process management depends on good data.

However, it is surprising how few appreciate the investment necessary to make sure we are, in fact, obtaining good data. The procedure for obtaining dependable process data is as follows:

1. Determine what needs to be measured, based on the following:
   - What the process delivers
   - Who receives the deliverables
   - What the deliverables must do for the recipient
   - What kind of measurement will track objectively whether those needs are being met
2. Determine whether relevant data can be obtained from existing information systems
3. If new data must be obtained, then develop and implement operational definitions to ensure consistent and dependable data collection
4. Conduct statistically valid measurement systems analyses to verify that measurement variation is acceptably small, compared with process requirements

Before organizations begin their journey toward MBNQA or its counterparts, they often gather a lot of data that is virtually irrelevant to their processes. Consider crime statistics, particularly the kind that depend on victim reporting. Law enforcement professionals verify that some crimes go under-reported, sometimes virtually unreported, depending on the stigma attached to victims in their respective societies.

Could anything like this be happening in business processes? Here is just a partial list of ways in which process data can be reported inaccurately:

- Errors corrected before they are formally detected (example: so-called "punch sheets" on construction sites, essentially a list of rework that is performed, but seldom tracked)
- Outcomes concealed due to fear of personal consequences (example: test failures that are hidden lest they jeopardize arbitrary shipment goals)
- Outcomes that can be reported a number of different ways, so they are (example: Byzantine diagnosis and treatment codes in healthcare)

Clearly, step 1 of the above procedure may demand the most integrity and fortitude of all: A willingness to scrutinize one's data streams in an entirely new and potentially unflattering light. A thorough discussion of how to do so, and how to rectify such a situation, is beyond the scope of this paper. However, we hope it goes without saying that customer-focused process management depends upon customer-focused process data. Lawton[2] provides a good starting point for further study.

Let us proceed to the second step. Far too often, information systems are poor sources of process data, because they were designed instead to handle accounting and purchasing. Some individual systems may provide data and file transfer functions, but only in blocks of events, not on the individual-event basis that gives the best information. Finally, some systems readily accept data, but appear reluctant to release it for process analysis.

Ideally, statistical thinkers should be included in specifying, comparing, designing, and qualifying any new systems, possibly even taking a leadership role in the task. Failure to do so actually has been known to result in systems that are more impediments than aids in obtaining valid process data.

The third step is activated in the event that automated or historical streams of data fail to meet the requirements of step 1. An "operational definition" is a set of specific instructions about when, where, and how to obtain data. If you think operational definitions are unnecessary, try answering the question in Figure 2. The best course of action is to anticipate and define as much as possible in advance.

Figure 2 Why We Need Operational Definitions

An effective example of operational definitions is the rules of most major sports – even a casual baseball fan knows which events contribute to a player's tally of times at bat: a hit, a walk, an error, etc.

A classic example of fallout from waiting until after the fact would be the "hanging chads" episode of the 2000 presidential election in the United States. Because the definition had not been established in advance, the Supreme Court had to replace statistical thinking with judicial methods. At that point either electoral outcome would have left roughly half the voters feeling cheated.

Once we have sound operational definitions, we need to quantify measurement variation. Most people seem receptive to the notion that processes experience variation. After all, evidence of process variation is abundant and obvious. Less intuitive is to recognize that gathering process data is in itself a process, as Figure 3 shows. Not only can measurement variation exceed process variation, but at some extremes the data gathered is virtually irrelevant to what is going on in the process.

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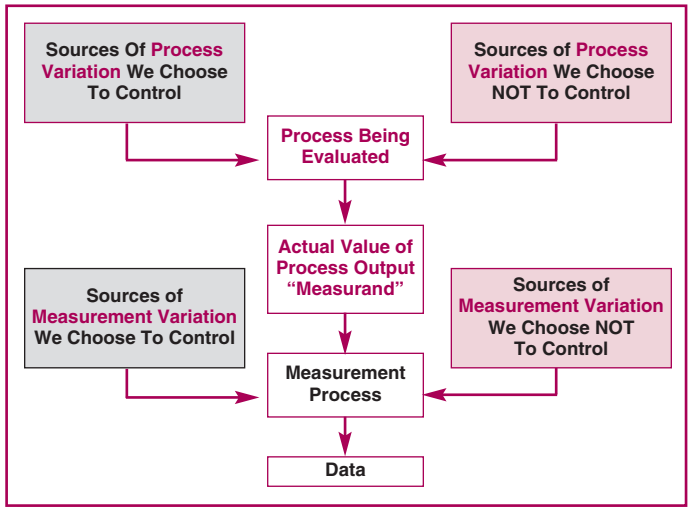

Figure 3 Measurement as a Variable Process

Clearly, the four-step process described here constitutes a non-trivial effort. However, in the context of customer-focused process management, we hope the reader will appreciate these as a wise investment. Without confidence that we have relevant and dependable process data, all subsequent analyses and decisions are at risk.

Common Cause vs. Special Cause Variation

"To know and not to do is not to know." – Chinese proverb

In the aftermath of the ground-breaking 1979 NBC television documentary entitled "*If Japan Can, Why Can't We?*" the expression "statistical process control," or SPC, became a popular 1980's buzz word. Although SPC has a relatively narrow formal definition, for a time the term informally came to encompass virtually all of statistical thinking and data driven decision-making.

However, let us focus on the narrow definition of SPC: making process decisions based on whether the process exhibits common cause or special cause variation. Thousands upon thousands of people observed Dr. Deming conducting "The Red Beads," and subsequent practitioners have propagated the lessons to many thousands more. The key lessons of The Red Beads are:

- Common cause variation is an inherent characteristic of the process as currently operated. Only a fundamental change in the design and operation of that process will change its behavior.
- A process exhibiting common cause variation will not respond to slogans, exhortations, threats, consequences, counseling, training, or any other individual-event response when people are following instructions. All such responses constitute a waste of resources.

It is frustrating to hear decision makers insist that they understand common cause vs. special cause variation, even as they relentlessly invoke special cause responses to common cause situations. This explains the adage at the start of this section. Putting it as bluntly as possible:

Invoking special cause responses to common cause situations constitutes bad process management, bad human management, and just plain bad management.

If this comes across as overly harsh, consider the opportunity awaiting those who make the transformation. Instead of consuming people's time with attending extra meetings, counseling individuals, or preparing reports, explanations, action plans, etc., those resources can do the real work of the organization. Now perhaps you know where to find the resources to validate your measurement systems!

Please indulge one final admonition: avoid the trap of insufficient data points. One example is the popular practice of comparing pairs of numbers, such as the current quarter against either the prior quarter, or against the same quarter of a year ago. Another is the thirteen-month cycle, in which anything prior to the same month last year simply "rolls off" the chart. Neither approach is statistically valid, making bad decisions a significant risk.

The best practice is to seek a reasonable number of observations, no fewer than roughly 20, and perhaps no more than about 100. In such a scenario, there is a good likelihood that the kind of variation will become self-evident, and that ensuing decisions will reflect good process management.

Conclusions

Customer-focused process management depends on: 1) data that dependably reveals how well our processes meet customer requirements, and 2) a means of interpreting the data that leads to the right decisions.

The techniques of statistical thinking and data-driven decision making provide the basis for making this happen. Once we have good data and good decisions, we are poised to reflect the words of General Electric's former CEO Jack Welch:

"One thing we have discovered with certainty is that anything we do that makes the customer more successful inevitably results in a financial return for us."

[1] G. Britz, D. Emerling, L. Hare, R. Hoerl, & J. Shade: *Statistical Thinking: Special Publication of the ASQC Statistics Division*, American Society for Quality Control, Milwaukee, WI, Spring 1996

[2] Robin Lawton: *Creating a Customer-Centered Culture*, ASQ Press

MBNQA - Malcolm Baldridge National Quality Award

Jonathon Andell, President of Andell Associates, specializes in the technical, organizational, and interpersonal aspects of modern Quality Management. He has published numerous articles on statistical methodologies, Six Sigma Design, quality management, and business ramifications of Six Sigma. Jonathon has a BS Metallurgical Engineering from Purdue University and MS Metallurgy from The Pennsylvania State University. He is a Senior Member of the American Society for Quality (ASQ), and a Member of The Institute for Electrical and Electronic Engineers (IEEE). He can be reached at ***js@hotmail.com.***

IN CASE YOU MISSED IT

The 51st Annual Fall Technical Conference will be held in historic Jacksonville … Where Florida Begins, on October 11-12, 2007

The theme of the conference is Statistics and *Quality … Where Discovery Begins*. The conference will feature the latest developments in statistical methods as they relate to quality improvement and decision-making and will highlight discoveries in unique and innovative statistical methodologies and quality tools. The technical program will include presentations on the following topical areas: multiple response optimization, analysis of attribute data, nonparametric control charts, analysis of factorial experiments, measure systems assessment, robust design, topics in modeling, reliability, skewed and/or censored data analysis, design of experiments, change point estimation, and advanced topics in SPC.

There is sure to be something for everyone, so mark your calendar and begin making plans to be in Jacksonville, Florida for the Fall Technical Conference. For more information contact John Cornell at jcornell65@cox.net or visit our Web site http://www.asqstatdiv.org for the conference program as the event draws nearer.

8th Annual Six Sigma Leadership Conference, May 7 – 10 (Scottsdale, AZ)

For more information call the International Society of Six Sigma Professionals at 480-368-7083 or visit their Web site at http://www.isssp.com/.

ASQ Re-certification Deadline Approaches

The deadline to resubmit recertification journals for the following certifications is June 30; Quality Auditor, Quality Engineer, Reliability Engineer, Software Quality Engineer and SSBB.

American Statistical Association 2007 Joint Statistical Meetings

The Salt Palace Convention Center, July 29 - August 2, 2007 (Salt Lake City, Utah)

Different Roads to Take for Data Analysis

by Christine Anderson-Cook

For most of us with some formal training in statistical methods — from a single course to an advanced degree — the starting point of this part of our education typically began with classical or frequentist methods for analyzing data. Later, we might have been shown a Bayesian analysis for the same problem.

Upon graduation, I sensed these methods were fundamentally different in their approaches to analyzing the data,the assumptions inherent in using the methods and the ways of interpreting the results. This information seemed jumbled and confusing.

I was left with the impression that statisticians and those who use statistical methods face a fork in the road early in their careers — a single irreversible decision that determines the path they take — frequentist or Bayesian — during their statistical years.

A complete comparison between the two approaches is certainly beyond the scope of this Statistics Roundtable column. But highlighting some of the similarities and differences between the frequentist and Bayesian approaches might help more engineers and scientists using statistical methods understand some of the trade-offs.

This will help in deciding which approach is better suited to a given analysis. Indeed, different problems are better suited to one approach or the other. Although there are many who will disagree with me, I believe the choice between frequentist and Bayesian paradigms is one that can be made appropriately on a case-by-case basis.

Common Features

A useful starting point is to review some of the features common to both approaches:

- Both are parametric approaches with an underlying statistical model with parameters to be estimated.
- Both need to connect the observed data to the parameters through a specified relationship defined by a distribution in the likelihood function.

Trade-offs between frequentist and Bayesian approaches must be weighed.

Recall that the likelihood function is closely related to the probability distribution function and considers the joint probability function of the observed data as a function of the parameters of the selected model, with the goal of finding the best parameter values given the observed data.

Indeed, formulating the statistical model from subject specific knowledge can be completely separated from the choice of analysis approach.

Differences in Approaches

How the models are used for estimation and inference then diverges. The frequentist approach commonly uses maximum likelihood or least squares estimation to find the choice of the parameter values that makes the observed data most likely under the specified likelihood function.

The Bayesian approach seeks to integrate across the parameter space to combine the prior distribution of the parameters with the information from the data contained in the likelihood function to obtain a posterior distribution of the model parameters.

Other differences include:

Parameters: Fundamentally, the frequentist approach treats the unknown parameters to be estimated as fixed values,which are unknown. Namely, there is a target "correct" value for each parameter, such as the population mean that we seek to find. On the other hand, the Bayesian approach considers the parameters as random variables, which are both unknown and have distributions.

Data and expert opinion: Given the assumed model, the frequentist approach relies on the data as the only source of information to help determine point and interval estimates for the parameter values.

This focus on the data removes subjectivity from the analysis and gives the data maximum impact in determining the most likely values.

Alternatively, the Bayesian approach combines prior distributions of the parameters (which are a subjective assessment based on scientific or engineering knowledge about the parameters before the data are collected) with the added information from the data in the likelihood function to come up with an updated version of the distributions of the parameters based on the combined information of the two sources.

It is possible to use diffuse priors to reflect that not much is known a priori about the parameters, or the prior distribution can be quite narrow if much is already known about model parameters, from theoretical knowledge or previous studies.

The Bayesian approach allows the flexibility to formally incorporate specific knowledge from subject matter experts into the analysis. Depending on the goal of the study, it may be preferable to let the data stand alone with all results dependent on only what has been observed in the current study. Or it may be preferable to combine data and expert knowledge in a structured approach. If the amount of data is small, then the frequentist and Bayesian approaches can give quite different results. As the amount of observed data grows, the two approaches typically begin to converge at similar results.

When I was taught this distinction, the difference between the two approaches for small to moderate amounts of data was portrayed as a disadvantage of the Bayesian approach. The subjectivity of results based on expert opinion was deemed undesirable.

However, I have now come to appreciate that you want the results to differ depending on the additional information you have added through the prior distribution. If they did not differ, then what would be the benefit of including additional knowledge from previous studies or expertise?

If there is some uncertainty or disagreement among the experts, a sensitivity analysis of different prior distributions can be considered to understand the influence of various changes to the prior distributions.

If there is only a small amount of data, then the frequentist approach can lead to very wide confidence intervals for the parameter estimates.

If there is good knowledge about the model parameters, the increase in precision of the estimates from incorporating that information into the prior distribution may be very beneficial.

As you might expect, if the knowledge added through the prior distribution turns out to be incorrect, then the resulting posterior distribution can be biased. Hence, it is important to incorporate only additional information that has some firm subject matter basis.

Interval Estimates

Another important difference between the two approaches is the interpretation of the interval estimates obtained for the unknown parameters.

Since the frequentist approach is trying to estimate a fixed but unknown constant, a 95% confidence interval should be interpreted as a range of sensible values that under repeated sampling or running of the experiment would include the true parameter value 95% of the time. Thus the notion of the experiment being repeatable is intrinsic to the interpretation.

The Bayesian 95% credible interval for

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DIFFERENT ROADS TO TAKE FOR DATA ANALYSIS

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the unknown parameter (thought of as a random variable itself) gives the range of values for which there is a 95% probability (given the observed data and any prior knowledge included) of including the parameter value. This approach is natural for situations in which the experiment is not repeatable, and it is the commonly given, although erroneous, interpretation of what a confidence interval for the frequentist approach is providing.

The Bayesian approach is considerably more flexible for obtaining interval estimates for nonstandard questions.

For example, we might have a model for the data for which the model parameters are the mean and variance but be interested in estimating certain percentiles of the distribution of the observed responses, or a complicated expression in terms of several model parameters.

For the frequentist approach, typically these answers cannot be obtained directly from the parameter estimated values. However, this estimation poses little problem for the Bayesian approach.

Computational Intensity

Finally, one of the prominent features in the comparison of frequentist and Bayesian approaches historically used to be the computational intensity of the two approaches. Just 10 years ago, the implementation of the Bayesian approach for many problems was difficult, cumbersome and computationally very demanding.

However, with increased computing power and software such as WinBug (www.mrc-bsu.cam.ac.uk/bugs/winbugs/contents.shtml), this is no longer such a large consideration. While there is still more software available for frequentist analyses, the gap is closing quickly and this is a much less important consideration than it once was when choosing between the two approaches.

I would encourage those using statistical methods to be open and consider both the frequentist and Bayesian approaches.

The frequentist approach can be a solid choice for estimating many functions of the model parameters in cases in which no previous knowledge is available about the model parameters or there is considerable uncertainty about what is known.

The Bayesian approach can be a practical and beneficial choice to consider when there is subject matter expert knowledge about the model parameters, the experiment does not lend itself to the frequentist interpretation of repeatedly collecting the data, or a nonstandard function of the model parameters is of interest.

BIBLIOGRAPHY

Gelman, Andrew, John B.Carlin, Hal S. Stern and Donald B. Rubin, *Bayesian Data Analysis*, CRC Press, 2004.

Lee, Peter M., *Bayesian Statistics: An Introduction* , Oxford University Press, 1997.

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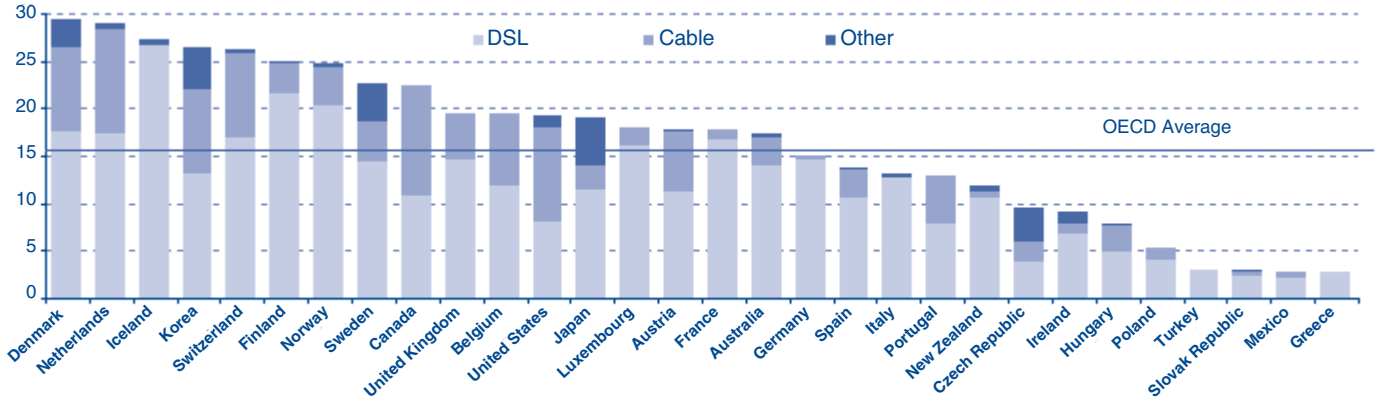
DATA MATTERS

OECD Broadband subscribers per 100 inhabitants, by technology, June 2006



Source: OECD For more information go to: http://www.oecd.org/document/9/0,2340,en_2649_201185_37529673_1_1_1_1,00.html

	DSL	Cable	Other	Total	Total Subscribers
Denmark	17.4	9.0	2.8	29.3	1,590,539
Netherlands	17.2	11.1	0.5	28.8	4,705,829
Iceland	26.5	0.0	0.7	27.3	80,672
Korea	13.2	8.8	4.5	26.4	12,770,911
Switzerland	16.9	9.0	0.4	26.2	1,945,358
Finland	21.7	3.1	0.2	25.0	1,309,800
Norway	20.4	3.8	0.4	24.6	1,137,697
Sweden	14.4	4.3	4.0	22.7	2,046,222
Canada	10.8	11.5	0.1	22.4	7,161,872
United Kingdom	14.6	4.9	0.0	19.4	11,622,929
Belgium	11.9	7.4	0.0	19.3	2,025,112
United States	8.0	9.8	1.4	19.2	56,502,351
Japan	11.3	2.7	4.9	19.0	24,217,012
Luxembourg	16.0	1.9	0.0	17.9	81,303
Austria	11.2	6.3	0.2	17.7	1,460,000
France	16.7	1.0	0.0	17.7	11,105,000
Australia	13.9	2.9	0.6	17.4	3,518,100
Germany	14.7	0.3	0.1	15.1	12,444,600
Spain	10.5	3.1	0.1	13.6	5,917,082
Italy	12.6	0.0	0.6	13.2	7,697,249
Portugal	7.9	5.0	0.0	12.9	1,355,602
New Zealand	10.7	0.5	0.6	11.7	479,000
Czech Republic	3.9	2.0	3.5	9.4	962,000
Ireland	6.8	1.0	1.4	9.2	372,300
Hungary	4.8	2.9	0.1	7.8	791,555
Poland	3.9	1.3	0.1	5.3	2,032,700
Turkey	2.9	0.0	0.0	3.0	2,128,600
Slovak Republic	2.2	0.5	0.2	2.9	155,659
Mexico	2.1	0.7	0.0	2.8	2,950,988
Greece	2.7	0.0	0.0	2.7	298,222
OECD	9.7	4.6	1.2	15.5	180,866,265
EU 15	13.7	2.5	0.3	16.5	

Source: OECD

TREASURER'S REPORT

Statistics Division

12/31/06

Revenue (as of Dec. 31, 2006)	2006-2007 Budget	YTD Actual
Dues	$60,000.00	$39,661.60
Retail Sales	$400.00	$20.00
Interest/Royalties	$1,600.00	$1,181.61
Teleclass Revenue	$0.00	$0.00
AQC Tutorials	$0.00	$0.00
FTC Short Courses	$0.00	$0.00
Total	**$62,000.00**	**$40,863.21**

Expenses (as of Dec. 31, 2006)

New Member Mailings	$1,500.00	$0.00
Teleconferences	$500.00	$0.00
General Fund	$2,000.00	$0.00

DAC Meetings (Nov., May)	3,000.00	4,578.13
Travel, Hotel	*3,000.00*	*4,578.13*
Strategic Planning (Mar., AQC)	6,500.00	1,329.64
AQC Meeting	*4,000.00*	*1,329.64*
AQC Travel	*2,500.00*	*0.00*
Operational Planning (Aug.)	7,000.00	10,149.77
Travel, Hotel, Meals	*7,000.00*	*10,149.77*
Tactical Planning (FTC)	3,000.00	955.46
FTC Meeting	*500.00*	*651.24*
FTC Travel	*2,500.00*	*304.22*
Long Range Planning (3 yrs)	0.00	0.00
Planning Committee	**$19,500.00**	**$17,013.00**
Auditing Committee	**0.00**	
Bylaws Committee	**0.00**	
Certification Committee	**0.00**	
Examining Committee	**0.00**	
AQC Exhibitor Fees	2,000.00	0.00
AQC Promotional Items	1,000.00	0.0
Membership Committee	**3,000.00**	**0.00**
Regular Newsletter (3)	2,500.00	0.00
Printing (Layout, pdf files)	*2,000.00*	*0.00*
Postage/Miscellaneous	*500.00*	*0.00*
Special Publication (even years)		
Spring 2004 - Six Sigma	10,000.00	0.00
Sp Pub Printing	*6,000.00*	*0.00*
Sp Pub Postage	*2,500.00*	*0.00*
Sp Pub Reprints	*1,000.00*	*0.00*
Sp Pub Honorarium	*500.00*	*0.00*
Newsletter Committee	**12,500.00**	**0.00**

Expenses (continued)	2006-2007 Budget	YTD Actual
Nominating Comm	**0.00**	
Programs Comm	**0.00**	
Publications Comm	**1,000.00**	**0.00**
Standards Comm	**6,000.00**	**0.00**
Promotions Comm	**0.00**	
Committees Sub-Total	**$42,000.00**	**$17,013.00**

Web Design & Maintenance	3,000.00	1,024.50
Narrated PowerPoints	500.00	0.00
Virtual Academy	0.00	
Outreach Projects	9,100.00	0.00
FTC Sponsorships	*3,500.00*	*0.00*
ISBIS Conference Short Courses	*0.00*	
Other	*$5,600.00*	*0.00*
Tactical Plans Sub-Total	**$12,600.00**	**$1,024.50**

Hunter Award (plaque)	300.00	441.21
Hunter Awardee Honorarium (travel)	1,000.00	0.00
Youden Speaker gift (FTC)	1,000.00	0.00
FTC Student Grants	1,500.00	0.00
ASQ Testimonials ($50 each)	100.00	0.00
Service Awards (AQC, FTC Reps)	300.00	0.00
Outgoing Chair's Gift	500.00	0.00
Awards Sub-Total	**$4,700.00**	**$1,394.41**

Misc/postage	100.00	0.00
Misc/travel	500.00	0.00
Misc/other	100.00	276.26
Misc- Sub-Total	**$700.00**	**$276.26**

Total Expenses	**$62,000.00**	**$19,708.17**

Ott Scholarship		**YTD Actual**
Assets		
Scholarship Fund	$200,000.00	*$238,608.09*
Expenses		
Scholarship (2)	$10,000.00	$10,000.00

Ending Balances (as of Dec. 31, 2006)		
Checking	$57,650.96	
Money Market	98,733.06	
Accounts Receivable	1,128.00	
ASQ	*1,128.00*	
Dividends		
Current Assets	**$157,512.02**	
Capital Assets	**6,413.00**	
depreciated to	**0.00**	
Long Term Assets	**$322,761.05**	
from reserve fund	*72,447.82*	
Ott fund	*$250,313.23*	
Total Assets		**$480,273.07**

STATISTICS DIVISION COMMITTEE ROSTER

Voting Members of STAT Council

2006-2007

Committee	Name	Division Position	E-mail address	Telephone
OFFICERS				
	Gordon Clark	Division Chair	gclark007@columbus.rr.com	614-847-1394
	Doug Hlavacek	Chair-Elect	douglas.hlavacek@ecolab.com	651-306-5833
	Daksha Chokshi	Treasurer	daksha.chokshi@pw.utc.com	561-796-8373
	Vivek Ajmani	Secretary	vivek.b.ajmani@ampf.com	612-678-2179
STANDING				
Examining				
Chair	Howard Swartz	Examining Chair	swartzhc@aaicorp.com	410-628-3278
Auditing				
Chair	Gordon Clark	Division Chair	clark.17@osu.edu	614-847-1394
By-Laws				
Chair	Geoff Vining	Past Chair	vining@vt.edu	540-231-5657
Nominating				
Chair	Geoff Vining	Past Chair	vining@vt.edu	540-231-5657
Program				
Co-Chair	Vivek Ajmani	Secretary	vivek.b.ajmani@ampf.com	612-678-2179
Co-Chair	Scott Kowalski	Vice Chair - Products & Services	skowalski@minitab.com	407-328-9609
Publications				
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Co-Chair	Scott Kowalski	Vice Chair - Products & Services	skowalski@minitab.com	407-328-9609
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Voting Member	Bill Rodebaugh	Special Publications Editor	bill.rodebaugh@grace.com	215-743-0406
Non-Voting Member	Rudy Kittlitz	Glossary & Tables Editor	rgke300@hughes.net	432-837-9937
Strategic Planning				
Chair	Gordon Clark	Division Chair	clark.17@osu.edu	614-847-1394
CONSTITUTED				
Tactical Planning				
Chair	Doug Hlavacek	Chair Elect	douglas.hlavacek@ecolab.com	651-306-5833
Promotions				
Co-Chair	Daksha Chokshi	Treasurer	daksha.chokshi@pw.utc.com	561-796-8373
Co-Chair	Mark Kiel	Vice Chair - Outreach	mhkiel@uss.com	219-888-3788
Non Member	Small Web Solutions	Web Master Contact	jwebster@smallwebsolutions.com	219-988-3139
Membership Needs				
Co-Chair	Daksha Chokshi	Treasurer	daksha.chokshi@pw.utc.com	561-796-8373
Co-Chair	Mark Kiel	Vice Chair - Outreach	mhkiel@uss.com	219-888-3788
Voting Member	Jonathon Andell	Membership Chair	jandell@hotmail.com	480-893-9004
Voting Member	Ed Schilling	Standards Chair	egscta@rit.edu	585-475-6129
Voting Member	Harry Koval	Certification Chair	hkoval@comcast.net	651-776-9503
Awards				
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Non-Voting Member	Lynne Hare	Ott Scholarship	lynne.hare@kraft.com	973-503-4154
Non-Voting Member	Todd Nelson	FTC Student Grants	trnelson3@mmm.com	651-737-4420
Non-Voting Member	Douglas Montgomery	Hunter Award Chair	doug.montgomery@asu.edu	480-965-3836
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UPCOMING NEWSLETTER DEADLINES FOR SUBMISSIONS

Issue	Vol.	No.	Due Date
Fall 2007	26	1	Aug. 31, 2007
Winter 2008	26	2	Nov. 30, 2007

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