

# A S Q STATISTICS D I V I S I O N

Newsletter ©

Volume 18, No. 2

Spring, 1999

## Chair's Message

by Don Williams



AQC '99 is now history! We had a very successful tactical planning meeting and an outstanding booth. **Bob Mitchell**, Chair-Elect, led us through a day of planning in

which we made great progress forward on our most critical tactical plans. We are now working toward delivering new products and services to our customers. **Nancy Belunis**, Publications Committee Chair, is leading the charge to get new publications ready. **Galen Britz** is leading the development of a short course that could be presented at local sections. **J. L. Madrigal**, Membership Chair, with the help of **Marcey Abate** and **Jim Lenhart** put together a very interesting booth displaying our updated website.

The Statistics Division again received the McDermond Award, Level 3, for outstanding management during 1997-98, thanks to the outstanding leadership of **Don Emerling**. Congratulations, Don. We are also pleased that our Fellow Nominee, **Steve Bailey**, was nominated a Fellow and was recognized at the Fellows Brunch and at the Awards Luncheon. Bravo, Steve. Also, we extend congratulations to **Raymond H. Myers** for receiving the prestigious Shewhart Medal.

Our Division website is developing very nicely. Jim Lenhart, Webmaster, has taken over the responsibility of developing and maintaining our website. He has expanded on the great start

that **Mark Kiel**, former Bulletin Board Administrator and Webmaster, achieved in developing our electronic presence. Mark has taken on the assignment of AQC Program Chair for the 2000 AQC. Marcey Abate, Electronic Commerce Chair, is working with Jim to expand our website, and is leading our efforts to develop the homepage as a means for the Division to conduct its business via the 'net.

Our homepage address is [www.asq.org/statdiv/](http://www.asq.org/statdiv/). We encourage you to visit and discover what is avail-

able. While you are there, please complete and mail a member volunteer form. Or, simply send Don Emerling a note expressing your interests and specifying the areas where you would like to work. We welcome anyone interested in working with Division committees. We all began by volunteering. Also, this is an opportunity to work with an outstanding group of people. We have a number of people working on some very interesting projects. We need for more members to get involved.

## Editor's Message

by Ralph St. John



Lots of things going on with this newsletter. There are lots of letters on the subject of Capability Indices, and there's a follow-up article by Bob Mitchell on the same subject. I think

you'll find this very interesting and

enlightening. I find the way in which Mitchell uses control charts to monitor Cpk to be a nice way to illustrate that Cpk is a random variable.

We also have a letter to the editor on the subject of simplified versus over-simplified analysis. What is the balance between doing the "correct" analysis and doing a "simplified" analysis that one can communicate to the "customer"?

As Don Williams pointed out, the AQC is over. We were very successful

Continued on page 3



## Inside This Issue

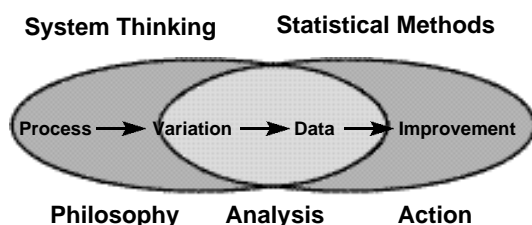
	Page		Page
Chair's Message .....	1	AQC 2000 Volunteers.....	17
Editor's Message .....	1	Volunteer Opportunities.....	17
Mission, Vision, etc .....	2	43rd Annual Fall Technical Conference .....	18
Letters to the Editor.....	3-11	MINI PAPER	
Division Officers.....	11	Improving K-12 Education Using Statistical Thinking: A Case Study of School Principals .....	20
Annual Quality Congress Committee Reports.....	12	TUTORIAL	
Membership Report.....	13	Cpk Plots – An Application of Individuals Control Charts .....	22
Annual Evaluation .....	15		
VOLUNTEERS			
Call for Short Course Chairs.....	17		

## MISSION

- Promote Statistical Thinking for Quality and Productivity improvement.
- Serve ASQ, business, industry, academia and government as a resource for effective use of Statistical Thinking for quality and productivity improvement.
  1. Our primary customers are Statistics Division members.
  2. Other key customers are:
    - a. Management
    - b. Users and potential users of Statistical Thinking
    - c. Educators of the above customers
- Provide a focal point within ASQ for application-driven development and effective use of new statistical methods.
- Support the growth and development of ASQ Statistics Division members.

## VISION

### Statistical Thinking Everywhere



## DESIRED DIVISION END-STATE

- Our members will be proud to be part of the 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:
  1. Greatest weight on intermediate level.
  2. Nearly as much weight on basic level.
  3. 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 view of quality management.
- Apply Statistical Thinking ourselves; that is, practice what we preach.
- Uphold professional ethics.
- Continuously improve.

## STRATEGY

- Design and deliver selected useable products.
- Have a strong and vibrant Division infrastructure.
- Demonstrate the broad effectiveness of Statistical Thinking.
- Integrate Statistical Thinking into educational curricula.
- Develop a vibrant information communication system.
- Influence key decision makers.

## Disclaimer

The technical content of material published in the ASQ Statistics Division Newsletter may not have been refereed to the same extent as the rigorous refereeing that is undergone for publication in **Technometrics** or **J.Q.T.** The objective of this newsletter is to be a forum for new ideas and to be open to differing points of view. The editor will strive to review all articles and to ask other statistics professionals to provide reviews of all content of this newsletter. We encourage readers with differing points of view to write to the editor and request an opportunity to present their views via a letter to the editor. The views expressed in material published in this newsletter represents the views of the author of the material, and may or may not represent the official views of the Statistics Division of ASQ.

## 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.

# LETTERS TO THE EDITOR:

## Note from the Editor:

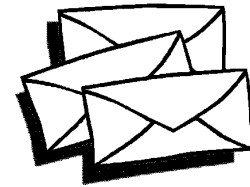
The first two letters printed below are re-printed from previous newsletters. We are including them here for completeness, and so that our readers can appreciate or understand the nature of the discussion.

Ralph St. John

To the Editor:

The article entitled "**Data 'Sanity': Statistical Thinking Applied to Everyday Data**" by Davis Balestracci published as a Special Publication by the ASC Statistics Division is long enough and deals with an important enough subject to provoke some serious discussion. Here are my comments.

First, my compliments to the author for an entertaining recital of the difficulties we all have had as a result of inadequately informed people attempting to interpret tables of data. As R. A. Fisher put it in his classic book *The Design of Experiments* "... the subject matter of this book has been regarded from the point of view of an experimenter, who wishes to



carry out his work competently, and having done so wishes to safeguard his results, so far as they are validly established, from ignorant criticism by different sorts of superior persons." Mr. Balestracci is concerned with avoiding ignorant analysis by different sorts of superior persons.

In the course of this tutorial piece the author puts down conventional statistical analysis, for example, "Statistics from Hell 101". In place of this he proposes to show how simple techniques such as runs tests can be applied to an individuals chart to expose the information it contains. It would seem to me to be more useful to motivate the reader to return to his statistics text now that he has a need for the subject that is both personally real and practical. It is the absence of these two characteristics that probably made the statistics lectures so easy to forget.

The first example (page 8) deals

with data from a hospital satisfaction survey. Nineteen months of data are given. Using a run-length test, it is concluded that no change has occurred over the 19 months. But suppose that the data were examined after the first year of attempting to improve customer satisfaction. A linear regression analysis of the results of the first year shows a significant trend up ( $p = 0.004$ ). The run-length test does not specifically address the question: Is quality of service improving? This test is more aptly applied to the question: Was there a jump (as opposed to a trend) in the quality of service?

Interpreting survey results is a difficult and sometimes dangerous business. But consider this scenario for Example 1: service improved over the first year. By the second year the new level of service had become the average in the eyes of the respondents, and they began to rate it that way.

Continued on page 4

## STATISTICAL THINKING

Statistical Thinking is a philosophy of learning and action based on the following fundamental principles:

- All work occurs in a system of interconnected processes,
- Variation exists in all processes, and
- Understanding and reducing variation are keys to success.

Statistical Thinking is a way of thinking, a thought process, rather than a method for calculating. The Statistics Division Vision "Statistical Thinking Everywhere" incorporates the interaction and strong interdependence between the philosophy of Statistical Thinking and the body of knowledge called Statistical Methods.

## EDITOR'S MESSAGE

Continued from page 1

in meeting people in our booth, recruiting new members and new volunteers, and showing people our new webpage. There are reports inside from many of the Stat Division committees. Please read the reports. If something interests you, volunteer. We can always use help. Speaking of help, I've accepted offers for help with the newsletter.

Two new people will be working with me on the newsletter. They are; Steve Boose, who works for Fulton Industries in Bowling Green, OH (Steve was a former student.) and Sandy Capone, who works for Kodak in Rochester, NY. We're still trying to find our roles, but I'm hoping that Steve will be able to edit the "Letters to the Editor" and that Sandy will be able to

take over reporting on the FTC and/or AQC. We'll see how it goes. Hopefully, by this time next year one of these two people will be taking over the editor's position.

I really appreciate those letters to the editor. It makes life more interesting and rewarding when I hear from the readers. Keep those cards and letters coming! It's your newsletter. Thanks for the feedback!

Coming up in the next two issues of the newsletter: a. The Summer, 1999 issue will be an extensive article by Mary Leitnecker (Univ. of Tenn.) on the subject of Statistical Thinking, particularly as it applies to production/manufacturing. Beth Propst is editing the Special Edition of the newsletter. b. The Fall, 1999 issue will highlight the upcoming Houston FTC.

The second example (page 9) is another instance of a technique driving the analysis rather than a question driving the analysis. A run chart of "Sweat Index" is shown for data after a change (improvement?) following point number 6. A number-of-runs test is applied and found not to be significant (at  $\alpha = 0.05$ ). Case closed. However, suppose we test the hypothesis that no change occurred following the 6th point versus that an improvement occurred. Using the rank sum test (no actual values are given, but ranks can be applied) produces a result significant at the 0.0009 level. Now the conclusion is that there was definitely a reduction in the Sweat Index following point number 6. The number-of-runs test, even with  $\alpha = 0.05$ , has failed to reveal this result. The statistical test should always be matched to the question.

Despite the fact that the author makes light of using  $\alpha = 0.05$  (as well as the 95% confidence interval), he gives Table 4.2 (page 10) which uses  $\alpha = 0.05$  (unlabeled) for each of the Lower Limit and Upper Limit for number of runs. (A table for  $\alpha = 0.005$ , which is a lot closer to "three sigma" significance, is readily available.)

It is interesting to speculate on why the author uses the 0.05 level of significance for the number-of-runs test. This test has poor efficiency, which relates to its capability to detect a real effect. The frequency with which real effects can be detected can be increased by using a larger significance level (e.g., the 0.05 level instead of the 3-sigma level of 0.00135). But the price to pay for this is an increase in the frequency with which an effect is declared real when it is not. A poor test cannot be made into a good one by simply changing the level of significance.

Plotting data is essential. The simple run chart (individuals plotted in time sequence) provides a very useful first look. But automatically applying runs tests to test whatever hypothesis is of interest is not good

statistical practice. "Statistical Thinking" gives one the correct viewpoint. But, this thinking combined with two runs tests does not constitute much of a set of tools. Anyone who wishes to do general statistical analysis had better look a little more kindly on Statistics 101 and refresh his memory on the wonderful array of tools that is available.

In the section entitled "How Many Standard Deviations" (page 23), the author quotes "Shewhart, Ott, Deming, Joiner, Wheeler, and Hacquebord" as recommending "three standard deviations". This is an impressive list of names but is misleading because the author is referring to the Analysis of Means; whereas Shewhart, Ott, and Deming were referring to the Shewhart control chart. The Analysis of Means is exactly analogous to the one-way Analysis of Variance; it has nothing to do with control charting. One might just as well recommend that the critical value of 3 always be used for Student's t test, which the Analysis of Means becomes when there are only two means. The significance level (and hence the critical value) for a statistical test is chosen according to the consequences of wrongly rejecting the null hypothesis. This is why Ott and others have published tables of critical values for a variety of significance levels for the Analysis of Means.

The author has done a service in his presentation and explication of numerous real-life examples. But I think he has also done a disservice by illustrating applications of "quick and easy" statistical tests using examples for which they are not appropriate, for misrepresenting the Analysis of Means technique, and by presenting the idea that essentially nothing is lost if one has forgotten what was presented in statistics 101. People would be better advised to renew their acquaintance with basic statistics. Statistical Thinking is only the prelude.

Dr. Lloyd S. Nelson  
Londonderry, NH

To the Editor,

Folklore has it that Vince Lombardi, late coach of the Green Bay Packers, used to begin each football season with this speech to his team: "We will begin with the basics. Gentlemen, this is a football." Coach Lombardi's focus on basics – blocking and tackling – and his belief in executing simple plays with consistent perfection – created a football dynasty. Coach Lombardi was a man that understood how to improve football quality – reduce variation.

Thinking about the importance of basics in achieving success brings me to Davis Balestracci's paper, "**Data Sanity, Statistical Thinking Applied to Everyday Data**", and Dr. Lloyd Nelson's criticisms of it. Recently, when my management asked for help with a better way to present and analyze organizational performance data, I would not, and did not refer them to a basic text on statistics. Instead, I discussed and presented them with a copy of the author's paper. Mr. Balestracci's approach is to teach by demonstrating examples of practical applications. And we desperately need practical applications of statistical thinking – not just theory.

The Statistics Division's Mission, Vision, Principles, and Strategy identifies its members as primary customers and the greatest market focus as intermediate and basic levels. Education, learning and knowledge of basic statistical tools and statistical thinking are critical to the development of ASQ's membership. With due respect to Dr. Nelson, us real world quality practitioners desperately need basic statistical tools. I commend Davis Balestracci for his important contribution to our understanding and use of basic statistical tools for data analysis.

Thomas C. Tribble  
Thomas\_C\_Tribble@apimc01.rl.gov

Continued on page 5

To the Editor,

I read with amusement and consternation a letter to the editor written by Thomas Tribble in which Mr. Tribble attacks Dr. Lloyd Nelson. Dr. Nelson had previously written a letter to the editor pointing out the technical inadequacies and downright inappropriate data analyses in the article "Data Sanity, Statistical Thinking Applied to Everyday Data" by Davis Balestracci. The Statistics Newsletter should never have published Mr. Balestracci's article without technical commentary from professional Statisticians.

Mr. Tribble attempts to draw a comparison between Mr. Balestracci, with his "just dumb it down" approach to statistics, and football coaching legend Vince Lombardi. Somehow Mr. Tribble believes that the naive and technically inept analyses of Mr. Balestracci are analogous to the "basics" that Coach Lombardi so strongly preached. Coach Lombardi was the quintessential perfectionist in life and in sports.

Let me educate Mr. Tribble. In the world of industrial statistics Dr. Lloyd Nelson is a Vince Lombardi and the point of Dr. Nelson's letter was very clear. There are fundamental principles to be followed in statistical thinking and analyses. Dr. Nelson pointed out the fundamental errors committed by Mr. Balestracci's "dumb it down" method, where one discovers that Individual and Moving Range Charts are the just about the only statistical tools worth using, even when the data do not come from a time series!

Quality practitioners like Tribble and Balestracci represent the downside of today's quality profession, where we find a host of intellectually lazy practitioners who would rather fix every problem with a statistical hammer, as opposed to taking the time to become properly educated and trained in the use of more technically challenging tools. In lieu of critical thinking and personal study, these individuals prefer to delude themselves and their clientele into believing that technical sloppiness and lazy, shallow thinking are good enough to solve difficult

problems. Balderdash! This is existential dishonesty in its purest form.

The fundamental statistical tools are not trivial to master and were never intended to be dumbed down to the idiot level. Technical subjects are hard to master, often they are damn hard to master. This is no excuse for gutting the content of a technical discipline and pretending the hollowed-out shell is good enough. Just as in any technical profession, there are fundamental principles and practices that must be adhered to if a practitioner is to provide appropriate solutions to difficult problems. Should we dumb down architecture to the point that we just tell practitioners, "If you build a bridge be sure to use triangulated structures"? The last statement may seem absurd but no more so than applying Individual and Moving Range charts to every form of data imaginable, without regard to the assumptions behind the tools or consideration for the appropriateness of the application.

As to the argument that you have to make the analyses and solutions understandable to a general audience (say, senior managers), the problem does not lie with the audience's inability to comprehend difficult concepts. The problem lies with inept explanations from poorly trained practitioners who have not taken the time to understand the subject themselves, let alone explain it to others.

I am an academically trained and highly experienced industrial statistician. I have never had a problem conveying complex ideas and analyses to general audiences. Why? Because I have always taken the time to understand my subject matter thoroughly and I have taken the time to find ways to clearly communicate with audiences not trained in statistics. Never blame others for your own inability to communicate.

Somehow I cannot imagine the late, great Coach Lombardi exhorting his players to find the easy way out or to avoid the hard work because a modest effort is "good enough."

Individuals like Mr. Tribble ought to spend the time necessary to understand the fundamentals instead of attacking truly great practitioners like Dr. Lloyd Nelson. Practitioners like Dr. Nelson demand that those using statistical methods have a command of the fundamentals and they demand that those practicing the statistical discipline adhere to high standards of professional conduct. Dr. Nelson is a quintessential perfectionist in the field of industrial statistics.

I also suggest that Mr. Tribble read Dr. Douglas Montgomery's Youden address for 1998. I believe Mr. Tribble will discover that the "dumb it down" crowd is being found out for the technical frauds that they are. The competitive nature of today's business climate and the customer's insistence upon high quality products require the implementation of comprehensive and correct statistical methods -- no, the Individual and Moving Range charts are not the primary statistical tools of choice.

Personally, I am sick and tired of statistical "hacks" who prefer to "dumb the subject down" rather than expend the effort to educate themselves. Isn't continuous learning a form of continuous improvement? Paraphrasing Richard Feynman, "Always simplify, but not so simple that the content is lost."

Philip J. Ramsey, Ph.D.,  
PIRSTATS@aol.com

From the Editor:

There is little doubt that the technical deficiencies in Mr. Balestracci's analyses, pointed out by Dr. Nelson, **are real and unacceptable**. Dr. Nelson did not advocate a more complex analysis, nor did he advocate a fuzzier, less clear explanation of the results. What Dr. Nelson advocated is first of all, **do the correct analysis**.

Moreover, the notion, expressed by Mr. Balestracci, that readers should forget everything they learned in their "Statistics from Hell" college class makes for great humor, but would do

Continued on page 6

great damage to the goal of educating managers in Statistics and Statistical Thinking. College statistics instructors don't teach the wrong material so much as they don't succeed very well in motivating the student of the importance and relevance of the material, and how students should explain their results. **Too many of us grade based on ability to calculate rather than on ability to communicate.** Those who suggest that college statistics classes are a waste should work to improve that situation rather than making such outrageous comments.

Mr. Balestracci is correct in his belief that many statistical analyses are ignored, either because the results were poorly explained to management or because management was not properly prepared to grasp the results. Whatever the reason, if a good statistical analysis is ignored we are all losers. And if management loses faith in Statistics, as a result of receiving and ignoring statistical analyses that management couldn't understand, then we again are all losers. Mr. Balestracci has chosen to address that issue by concentrating on using a few simple analyses that he finds easy to explain. I believe that is the wrong solution to a very important problem.

We can all agree that a great analysis will not be accepted if poorly explained. We can also agree that the wrong analysis with a simple easy-to-understand explanation is still the wrong analysis, and often the wrong conclusions.

In my 30 years of statistical consulting, I have tried to approach problems in two steps: #1. What's the real problem and what data and analysis are appropriate for addressing that problem? #2. How do I explain the results to my client? As an educator I have always insisted that my students be aware that they will, in the 'real world', be graded on their ability to meet both objectives. But I also tell them **that #1 should not be driven or preceded by #2.** When #2 takes priority over #1, then statistical ethics goes out the window.

There is no doubt that statistics educators must do better at preparing students to explain their analyses to 'customers'. But, to the student who says: "Moving Average charts are what I explain best!" and proceeds to use simple moving average charts to analyze a completely randomized fractional factorial design with five factors in 16 runs, I say: "Sorry, maybe you need to learn about fractional factorials, their analysis and the communication of the results."

What's the real problem? The statistical educators fraternity places great emphasis on developing new, improved and better methods and techniques for collecting and analyzing data, but puts far too little emphasis on **explaining** the results of the analysis to the customer. Perhaps the final hurdle for a student completing a degree in statistics should be for the student to present their work to a panel of both practitioners and educators/researchers. The student would be awarded a passing grade only if he/she is able to explain the importance of his/her work and its relevance in layman's terms.

Mr. Tribble spoke of the need to "teach by demonstrating examples of practical applications. And we desperately need practical applications of statistical thinking – not just theory." Amen! Dr. Nelson, Mr. Balestracci, Dr. Ramsey and I all agree with you! That need does not grant anyone a license to misapply statistical methods and misrepresent the teaching of statistics, supposedly in the name of "simplicity". To quote Mr. Tribble: "Education, learning and knowledge of basic statistical tools and statistical thinking are critical to the development of ASQ's membership." I agree completely. **But knowledge of basic statistical tools includes knowing when to use a tool and when not to use a tool.**

Communication has three major segments: 1. The message; 2. The messenger; and 3. The listener. If communication fails, is it always the message that is at fault? Perhaps the

messenger did not explain properly. Perhaps the listener was not properly prepared to listen.

Some have responded to the problem "management doesn't understand" by thinking that the only solution is to make the analysis simpler so "management can understand", regardless of whether the simpler analysis is correct. Is that the only solution? What about educating management so that they do understand? What about doing a better job of explaining the results to management? Both these choices strike me as better than that of 'oversimplifying' the analysis so management can understand.

We must focus on all three points:

- a. Educate customers to understand statistics and statistical thinking.
- b. Educate ourselves to better explain and interpret analysis.
- c. Educate ourselves to correctly use statistical thinking and statistical tools to solve problems.

We will only succeed if we work together, admitting to our shortcomings and honestly working together to overcome them. And, we can succeed if we focus on **all three** of these issues.

Ralph St. John

## Balestracci Responds

To the Editor:

It appears that the brewing feud between what I call the "PhD/Academic/Purist" and "MS/Industrial/Quick-and-dirty" has finally come to a head! So (pardon the jargon) I'm going to treat the brouhaha over my publication as a "common cause" and not a "special cause" (although I'll respond to some statistical issues raised by Nelson). Frankly, quick resolution of this foolishness is crucial. My message to both "camps" is: Get over it and merge! The statistics profession is in trouble! My style may have fanned a few flames, but at least this lurking issue is now on the table. Can we please deal with it once and for all?

Continued on page 7

We need to stop this “either/or” mindset. I’m not so presumptuous to suggest that what I espouse should replace traditional techniques in our profession’s typical context of formal consultation, design, and analysis. However, I admit that my challenge to teach basic ideas through different material with a different style may be a bit controversial.

The emphasis was on the inherent statistical issues in everyday work. Here’s my loose operational definition: “Everyday work” represents the processes that create our work environments. These processes produce data that drive organizational decisions. To further complicate matters, these data are rarely “designed,” and they are collected with no formal objectives in mind. The result is often data that are not “i.i.d.,” invalidating many traditional techniques. Like it or not, this changes the statistical “rules” that we learned and try to live by. Ignoring this issue is costly. Talk about an opportunity!

This especially affects us as a profession in administrative issues such as how businesses manage statistical departments and in the political issues that affect our interactions with clients and their departments. The publication was meant as a “wake up call” to the alleged statistical practices (especially the eight traps) that have many ramifications on the use and ultimate effectiveness of statistical groups. Wouldn’t it be refreshing if a consultation with a statistical group took precedence over yet another meeting to “explain” budget variances (most of which are probably common cause)?

**Given: *Whether or not people understand statistics, they are already using statistics.***

Of course, the traditional, more formal, statistical practices and research (design of experiments, test methods, process capability, etc.) must continue and be held to the rigorous standards espoused by Nelson, Ramsey, and St. John. I, too, have “been there ... done that” (I have a BS in Chem. Eng. and

an MS in Statistics). It is vital and necessary within our profession, but, in my opinion, not sufficient for its survival in the current economic climate.

For many, researching sophisticated ways of enhancing traditional tools is a professional turn on. We need you (I need you!) because for me, it is not. We as a profession have complained for years about how “misunderstood” we are...and the whining continues (Mea culpa!). A common theme among Nelson, Ramsey, and St. John is that, “If we just explain it to ‘them’ enough and show ‘them’ the usefulness, ‘they’ will jump on board and welcome us with open arms.” Statisticians being statisticians, linear logic from typically linear-thinking people. How long have we been singing that song? Sorry...I beg to differ.

Did you see the excellent article by Hahn and Hoerl (1998) (especially the comments by Margaret Nemeth and Ron Snee) for the wake-up call that it was? Many of us risk being quickly replaced when, “smart” statistical software overwhelms the market. The time will come when new MBAs won’t wait for statisticians to make a “business case” to justify their existence—Maybe because these same MBAs have been “scarred” (scared?) from their business statistics courses? Activity will not impress them. Impact will.

So my interests have evolved to the “people/psychology” aspects of utilizing statistics for ultimate effectiveness. Guess what? We’re all on the same team and we need each other—you don’t want to do what I do all the time, and I don’t want to do what you do all the time, but we must learn from one another for the good of our profession.

Think of my publication as a modest first attempt, by an in-the-trenches MS statistician, to describe a complementary body of statistical knowledge that needs to be integrated into the whole statistical context—a controversial but necessary merging of Deming

thought with “traditional” thought. It requires viewing the world of consulting through a new lens. My exposure to this thinking at a 1988 Heero Hacquebord seminar actually had the unexpected consequence of my using “traditional” statistics much more effectively.

The natural inclination is to see the two bodies of knowledge as mutually exclusive. They are not. Clients have shared with me that the process-oriented (statistical thinking) context has an initially counter-intuitive, yet disarmingly simple elegance and power to it that leads to asking the right questions.

Nelson, Ramsey, and St. John’s remarks seem to reflect our tendency to be obsessed with, “Is it significant or not?” Why so black-and-white? Frankly, I don’t care. “Does the interpretation offer a reasonable explanation in the context of the process’s history?” and “Are the subsequent dialogue and action in that same context intelligent?” are much deeper issues for me. After 10 years of using these techniques, I am still amazed at how “traditionalists” underestimate their effectiveness.

Addressing some general themes among Nelson, Ramsey, and St. John:

- “Statistics from Hell” struck a big nerve. Sorry. It’s our biggest opportunity to leverage our future and, because of changes in our work environments, needs to be radically redesigned. We need to stop taking the “This is good for you. Let me explain it one more time. Gee, if you only could see things the way I see them...” approach. This attitude can be viewed as patronizing and antagonize many participants. Unless they discover statistical virtues for themselves, within themselves they will continue to inappropriately apply basic techniques to data that do not come from stable processes.

Continued on page 8

My ideas are similar to Don Wheeler's: Teach statistics through understanding variation. We can argue about p-values, but the concepts of common and special causes are always present and provide a framework for virtually all statistical techniques. And how about calling a time plot a "time plot" instead of "stochastics."

How many MBA statistics classes talk about common and special cause? How many talk about taking a process view of management data and plotting it over time? These may be our future bosses! Joiner (1994), Langley et al (1996), Wheeler and Poling (1998), and Wheeler (1993) are excellent references to consider.

- I don't feel that the techniques I used were invalid given the context of the data collections. People were studying process behavior, the data were "given," and that was all they had. Under these circumstances, my experience is that concepts of "rigor," "efficiency," and "significance" start to blur.

If these had been formal consults planned from scratch, it would have been *unconscionable* to rely solely on the analyses I demonstrated. However, sometimes, after the formal, correct, statistical analysis, I also present a simpler picture form to my client, if it visually confirms the analysis.

Dr. Ramsey, people who take the "easy" way out and plot the dots are hardly lazy. Wheeler (1993) attributes a quote to Walter Shewhart: A data summary should not mislead the user into taking any action that the user would not take if the data were presented in a time series.

- **Key point:** Everyday context means "unplanned" data as a given vs. the "luxury" of "planned" data.

The boundaries of "traditional" analysis can become badly compromised. "Plotting the dots" is always a

good first step. How much time do you spend consulting with people who bring you data ("And it's good data!" they proudly tell you) and want you to "massage" it?

- I never implied, as Dr. Ramsey alleges, that "Individual and Moving Range Charts are ... just about the only statistical tools worth using, even when the data do not come from a time series!" I wasn't suggesting a one-size-fits-all "hammer" approach to data analysis. Let me challenge some of you: Is using a jackhammer to drive a tack any different?

Comments addressed specifically to Dr. Lloyd Nelson:

Dr. Nelson, you have been a virtual mentor to me for most of my career. I'm in awe of your theoretical knowledge, and I'm glad your many excellent references are at my fingertips. I know you were a friend and trusted colleague of W. Edwards Deming. I also knew you would fault my perceived lack of formal "rigor" and probably respond in print. I appreciate your thoughtful attempt to hold my feet to the fire, but, frankly, I was puzzled by some of your reactions. For instance:

- "The author puts down conventional statistical analysis ... In place of this he proposes to show how simple techniques such as runs tests can be applied to an individuals chart to expose the information."

It was not my intent to put down conventional analysis, but rather, conventional statistical education. I feel there should be an emphasis on the thinking process to intelligently discuss variation. Despite our good intentions, many participants tend to see techniques as ends in themselves.

My intent was just to get people to "plot the dots." A lot happens the first time someone does this. One must ask questions, clarify objectives, contemplate action, and review current use of the data. This leads immediately to

unexpected deeper understanding of the process, establishing baselines for key processes, and then allows honest dialogue to determine meaningful goals and action.

- "It would seem to me to be more useful to motivate the reader to return to his statistics text now that he has a need for the subject that is both personally real and practical."

Logical, simple, obvious ... and not my experience at all. With all due respect, statisticians have been deluding themselves with this view for years. What you said in 1974 (Nelson (1974)) could have been written yesterday:

To one outside a field, the only thing worse than an arcane vocabulary is the use of familiar words with new meanings. Statistics probably leads the world in this practice. Unfortunately, it doesn't stop there. For example, over the years the statistician has painted himself into a corner of his consulting room by "explaining" to engineers that he will evaluate their treatment averages by analyzing their variance. Further, if pressed (and some of us don't have to be pressed very hard) he may drop the information that the logic of the process lies in the fact that, for normal distributions (usually assumed), means and variances are independent.

In the face of such inscrutable reasoning, the engineer feels helpless, frustrated, and disenchanting. Who can blame him for reacting this way to a seemingly confused and tangled situation that somehow appears designed to exclude him from understanding what is taking place? Many experimenters simply turn away from statistics and return to their 'common sense' interpretations.

Continued on page 9

- Hospital Satisfaction Survey

This actual scenario was a typical case of a poorly designed ad hoc process. The whole point of the example was that the way the data were collected rendered any meaningful analysis moot.

Maybe there was a “significant” trend. Service may have improved over the first year and become the norm in the eyes of respondents. But given the method of data collection, (people have to see a table with surveys on it, take one and then complete it), how can anyone draw any real conclusions? Statisticians, in my experience (Mea Culpa!), are very good at doing this from the privacy of their insulated offices to justify a result. Eisenhower said, “To an engineer in an office with pencil and paper, farming looks pretty easy.”

The customer satisfaction survey was a routine item on a too-full staff meeting agenda. Management reacted to the monthly “two point trends,” ranked the clinics, and exhorted so much (all from afar) that it became a part of the process and “absorbed” into the chart’s control limits! No overt efforts were made.

- “A run chart of ‘Sweat Index’ is shown for data after a change (improvement?) following point number 6. A number-of-runs test is applied and found not to be significant (at  $\alpha = 0.05$ ). Case closed.”

You must have missed the last paragraph on page 9, where the number-of-runs test was indeed significant.

I am puzzled by the subsequent extensive discussion on “statistical significance.” I don’t feel the issue is black and white. I’m more concerned with intelligent dialogue and subsequent action. I’ve used that runs analysis table with great success over the last 10 years. It can serve as a prelude to motivate an honest discussion of the context and history of the data, usually to correlate organizational events to possible process changes. That’s when true analysis and

action begin. Time plots are non-threatening.

I didn’t “[make] light of using  $[\alpha] = 0.05$ ,” but, yes, I definitely made light of the ubiquitous and inappropriate use of 95% confidence intervals within an analytic framework. (You correctly point out that the runs test table had an alpha level of 0.05. I should have reported that.) Despite the discomfort with “0.05,” what’s the harm? Isn’t this better than blindly doing an Individuals control chart on all the data with inappropriate and inflated limits and a possibly incorrect average? What intelligent dialogue would that produce? I feel that the run chart tells the story beautifully.

- “Anyone who wishes to do general statistical analysis had better look a little more kindly on Statistics 101”.

When someone is handed data that makes them “sweat,” I am amazed at how often the contemplated action (hypothesis?) is poorly defined. When jobs already take up over 100% of their time, how can we naively expect non-statisticians “to refresh [their] memor[ies] on the wonderful array of tools that is available”? In their “spare” time? Before bed perhaps?

I think Thomas Tribble issues a wonderful challenge, “Recently, when my management asked for help with a better way to present and analyze organizational performance data, I would not, and did not refer them to a basic text on statistics.”

- “[T]he author quotes ‘Shewhart, Ott, Deming, Joiner, Wheeler, and Hacquebord’ as recommending ‘three standard deviations’”

As a matter of fact, I **was** referring to Analysis of Means (ANOM). After reading Ott’s book, your two articles (Nelson (1974) and Nelson (1983)) were seminal in my further development and my understanding of this woefully underutilized technique.

Maybe I got carried away and Shewhart’s name shouldn’t be on the list. I asked Joiner, Wheeler, and

Hacquebord about three standard deviations specifically in the context of ANOM. They all said “three.” I am well aware of, understand, and occasionally use Ott’s probability tables. Joiner studied with Ott and informed me that Ott himself used “three.” What about Deming? Isn’t the red bead experiment an Analysis of Means? Didn’t Deming use “three”? Didn’t Deming hate probability limits?

- “I think he has also done a disservice by illustrating applications of ‘quick and easy’ statistical tests using examples for which they are not appropriate...”

I disagree. Given the unplanned context of the data, they were quite appropriate and very insightful toward further analyses.

- “Analysis of Means is exactly analogous to the one-way Analysis of Variance; it has nothing to do with control charting.”

I agree that ANOM has nothing to do with traditional control charting, but may I refresh your memory regarding ANOVA? To quote again (Nelson (1974)):

[ANOM asks] whether the group harbors a criminal (who we would like to identify) ... [while ANOVA asks] whether there is evidence of criminality in the group as a whole (with less interest in pinning the crime on a particular person). Both methods test for lack of homogeneity among means but the hypotheses alternative to the null hypothesis of equality are quite different. For ANOM the basic alternative hypothesis is that one of the population means is different from the remaining ones which are equal. In essence it is an outlier test, particularly tuned to detect a single “aberrant” value...

Continued on page 10

For ANOVA the alternative hypothesis is that the variability among the population means is greater than zero. Because this procedure is sensitive to all kinds of departures from equality of means, it is less sensitive than ANOM for detecting a single different mean...

... The ANOM procedure is not focused on detecting only one outlying mean to the exclusion of detecting other outlying means...

I sometimes apply both ANOM and ANOVA to difficult data, and the Analysis of Means consistently gives a more insightful analysis of the situation.

- "...and by presenting the idea that essentially nothing is lost if one has forgotten what was presented in statistics 101."

I stand by my position that, as traditionally taught, the material and pedagogy have no ultimate value and may even lead to inappropriate use.

To conclude, my publication delivered exactly what was promised in the introduction and reiterated in the summary (along with the writing style issue)—no more, no less. As I said in the summary, I can't control emotional reactions due to misreading the intent. I stand by every word and analysis—from the perspective in which they were offered.

I did not reply to many specifics in Dr. Ramsey's letter and Dr. St. John's editorial comments. They articulated themes in common with Nelson, so they were addressed in general.

The attacks on my competence and the allegations of Dr. Ramsey's letter are thoroughly unprofessional. His use of the words "idiots" and "dumbing things down" in connection with our clients (or implying that is my motivation) is disturbing and insulting to clients as well as statisticians. Thomas Triple's heartfelt and thoughtful comments to Dr. Nelson were hardly an attack. I'll leave Drs. Ramsey and St. John a quote from Covey: "Seek first to understand, then to be understood."

Dr. Nelson, you were very professional and a gentleman. I have so much more to learn from you.

I thank Bob Mitchell, Statistics Division Chair, for inviting me to respond in this issue. I also acknowledge the valuable assistance of Stu Janis in preparing this response. Stu...you came through for me...again!

Davis Balestracci

Davis\_Balestracci@bluecrossmn.com

### References:

1. Hahn, G. H. and Hoerl, R. (1998). "Key Challenges for Statisticians in Business and Industry". *Technometrics*, 40, pp 195-213.
2. Joiner, B. L. (1994). *Fourth Generation Management: The New Business Consciousness*. McGraw-Hill.
3. Langlely, G. J.; Nolan, K. M.; Nolan, T. W.; Norman, C. L.; and Provost, L. P. (1996) *The Improvement Guide: A Practical Approach to Enhancing Organizational Performance*. Jossey-Bass, San Francisco.
4. Nelson, L. S. (1974). "Factors for the Analysis of Means." *Journal of Quality Technology* 6, pp. 175-181.
5. Nelson, L. S. (1983). "Exact Critical Values to use with Analysis of Means." *Journal of Quality Technology* 15, pp. 40-44.
6. Wheeler, D. J. (1993). *Understanding Variation: The Key to Managing Chaos*. SPC Press, Inc., Knoxville, TN.
7. Wheeler, D. J. and Poling, S. R. (1998) *Building Continual Improvement*. SPC Press, Inc., Knoxville, TN.

## Letters on Capability Indices

Dear Editor:

Thanks for publishing Robert Mitchell's paper on Capability Indices. We use them here to evaluate changes made to injection molding processes: new resins, new colorants, steel changes, new tools, etc. We measure critical dimensions on the injection-molded parts, and rely on Cpk, in large part, to determine if the process is capable of producing to our requirements.

Usually we have a sample of 80 to 160 for any given dimension (10 shots out of an 8- or 16-cavity tool). We calculate a single standard deviation from that entire sample - is this what

is referred to as Ppk in Mitchell's paper? How does he get the "weighted average of both within-group and between-group variation"?

Also, do you know how I could get a reprint of item 10 in Mitchell's bibliography?

Since I really have more questions than answers or recommendations, please don't put my name and address in the newsletter. Thanks.

Name withheld on request

To the Editor:

I saw your message in the ASQ Stat Division newsletter, and after eleven years at Intel, I naturally have an opinion about capability indices. I'll restrict my comments to Cpk; these comments apply to minor variants on this as well. I have tried to balance my "tirade" with both positive and negative comments.

### Bad things about Cpk:

1. Cpk is based on a fundamental lie: the existence of valid specification limits. Taguchi figured this out a long time ago. Expected loss based on his quadratic loss function, or upon the Upside Down Normal Loss Function (1) is a superior way to approach the entire problem of process capability:
  - a. Expected loss ranges (with the UDNLf) from zero to one - a bounded range that anyone can interpret.
  - b. Loss functions can be adapted to any actual loss pattern.
  - c. Expected loss does not require normality of the underlying process parameter - any distribution (or even a large sample of process data) can be used.

2. The correct (probability) interpretation of Cpk depends on assumptions that are often not met, and the violation of any of these assumptions means that the relation of Cpk to the percent out of specification is nonsense:

- a. Data must be normally distributed
- b. Cpk requires very well-characterized specification limits, and these often do not exist, so Cpk is often based on specification limits that have

Continued on page 11

little to do with real process requirements.

c. Cpk requires two-sided specification limits, and many process parameters (particle counts, for example) do not have these.

### Good things about Cpk:

1. Even the most dim-witted engineer can be taught to correctly compute Cpk most of the time.

2. Even the most dim-witted manager can be trained to bark when Cpk falls below a predetermined standard.

### Reference:

(1) Drain, David D., and Andrew M. Gough, [1995]. "Applications of the Upside-Down Normal Loss Function", IEEE Transactions on Semiconductor Manufacturing, Vol. 9, No. 1, pp 143-145.

David Drain  
david.drain@intel.com

To the Editor:

What's wrong with capability indices? Is there anything right about them? I will be brief, however. Nowhere in Mitchell's paper did he address the fact that Cpk is not a unique measure. Each of the infinite Cpk's = 1.33 have a different dpm (if that is your goal). Furthermore, the PCI values do not reflect the sample size or confidence level of the statistic, which of course makes the ranking use of PCI's useless. I hope to present a paper at either the AQC or FTC in 2000 that will address most of the issues related to these problems, using the basic concepts of estimating the parameters of statistical distributions.

Richard Post  
richard.post@intel.com

To the Editor:

My suggestion to statisticians and users of statistics is that they carefully review with an open mind the following articles in order to understand the Shewhart Control Chart and the topic known as Process Capability Indices. (You may also want to spend some time carefully considering what is said in these articles.)

1. Discussion: Integrating SPC and APC by Roger Hoerl and Andrew

Palm, Technometrics, August 1992, pp 268-272.

2. Notes on the Shewhart Control Chart by Lloyd Nelson, Journal of Quality Technology, January, 1999, pp124-126.

3. The Calculation of Process Capability Indices by Lloyd Nelson, Journal of Quality Technology, April, 1999, pp 249-250.

Alson Look  
Alson.Look@e-tek.com

To the Editor:

I have just read (with great interest) the article about Process Capability Indices in the latest issue of the Statistics Division newsletter. This is the most useful article I have read recently.

The Pp and Ppk statistics are new to me and I would like to learn more about "the overall standard deviation of the data." Is this the standard deviation of the entire data set? Or, could a portion of the entire data set be used? If so, how many data points or what percentage of the data set would be needed?

Laurie J. Scott  
Keokuk, Iowa

From the Editor:

Thanks to everyone who wrote with comments on capability indices. We appreciate your comments.

Please see the very applied problem-solving follow-up article on Cpk in this issue.

Readers who have questions, or want to discuss this issue further may wish to contact Mitchell directly at [rhmitchell@mmm.com](mailto:rhmitchell@mmm.com).

Ralph St. John

### On a Different Note...

To the Editor:

We seek your assistance in obtaining information similar to that found in the Stat Division Newsletter. Since this is a quarterly newsletter, is there a web site that we could access daily to obtain similar information about statistical literature and statistical tools, particularly those applicable in manufacturing?

Your response is much appreciated. Thank you.

Steven Ng  
Steven.Ng@sn.com.sg

Steven:

Your timing is perfect! Elsewhere in this issue you'll find a brief introductory piece about the revised Stat Division homepage. The URL is [www.asq.org/statdiv/](http://www.asq.org/statdiv/). Since May 17 you can visit the "Statistical Clearinghouse" from there. The Statistical Clearinghouse will provide software references, literature references, answers to Frequently Asked Questions (FAQ's), and a host of links to valuable statistical resources. We're very excited about this project, which is led by Marcey Abate and Jim Lenhart.

Ralph St. John

## STATISTICS DIVISION OFFICERS

### Chair

Don Williams  
Tel: (940) 243-1147  
Email: [d.r.williams@asqnet.org](mailto:d.r.williams@asqnet.org)  
Or: [drwilliams@sprynet.com](mailto:drwilliams@sprynet.com)

### Chair-Elect

Bob Mitchell  
Tel: (612) 736-8684  
Email: [rhmitchell@mmm.com](mailto:rhmitchell@mmm.com)

### Treasurer

Janice Shade  
Tel: (973) 682-6236  
Email: [shadej@nabisco.com](mailto:shadej@nabisco.com)

### Secretary

Jacob Van Bowen  
Tel: (804) 289-8081  
Email: [ybowen@richmond.edu](mailto:ybowen@richmond.edu)

# ANNUAL QUALITY CONGRESS (ANAHEIM, MAY 1999) COMMITTEE REPORTS

## Electronic Commerce Committee

Marcey Abate

### New Statistics Division Homepage.

Along with a new webmaster has come a new look and feel for the official division electronic homepage ([www.asq.org/statdiv](http://www.asq.org/statdiv)). The redesigned homepage provides our members and customers easy access to division products such as the Virtual Academy and Statistical Clearinghouse, contact information for division officers, committee chairs, and other volunteers, and details on upcoming conferences. New features added to the web page include the division philosophy and operating procedures, a list of available speakers by region, a comprehensive list and ordering information of division publications, and membership details. We expect the homepage and the Statistical Clearinghouse to become a standard reference resource for applications of Statistics and Statistical Thinking. Please visit and make suggestions. The homepage was redesigned by the Statistics Division's webmaster, Jim Lenhart, and the Electronic Commerce Chair, Marcey Abate. Send comments or suggestions to Marcey ([mlabate@sandia.gov](mailto:mlabate@sandia.gov)) or Jim ([jlenha@sandia.gov](mailto:jlenha@sandia.gov)).

**Statistical Clearinghouse.** The Statistical Clearinghouse made its debut in Anaheim. This is being developed by Marcey and Jim, and is intended to be a reference for applications of statistics. The Statistical Clearinghouse will provide software references, literature references, answers to Frequently Asked Questions (FAQ's), and a host of links to valuable statistical resources. This is a new and developing resource: suggestions would be most welcome by Marcey and Jim.

## Treasurer's Report

Janice Shade

Income YTD.....	\$85,968.00
"    Budget.....	\$134,000.00
Expenses YTD.....	\$70,820.15
"    Budget.....	\$120,000.00
NFB YTD.....	\$15,147.85
NFB Budget.....	\$14,000.00
Ott Scholarship Fund	
Actual Balance.....	\$252,536.53
Budget Balance.....	\$270,000.00
Expenses... YTD.....	\$30,000
"    Budget.....	\$20,000
Dated May 25, 1999	

## Certification Committee

Nick Martino

Committee activity has focused on the CQE exam. Martino serves as chair of the CQE Subcommittee of the ASQ Certification Board. Seventy division members (44 experienced, 24 with statistics expertise) have offered to help with CQE exam development.

A new Body of Knowledge (BOK) was recently approved. Statistics and SPC are now consolidated into an area called Quantitative Methods, which makes up about 33% of the exam.

ASQ has taken over administration of the CQE; it was previously subcontracted. The December 1999 CQE exam will be the first using the new BOK and the ASQ administration of the exam.

During the coming year the committee will emphasize standardization of learning objectives and exam development.

## Standards Committee

Ed Schilling

The committee is working on updating various ANSI/ASQ standards. These include:

- B1 Guide for Quality Control Charts.
- B2 Control Chart Method of Analyzing Data.
- B3 Control Chart Method for Controlling Quality During Production.
- S1 An Attribute Skip Lot Plan.
- S2 An introduction to Attribute Sampling.
- Q3 Sampling Procedures and Tables for Inspection of Isolated Lots by Attributes.
- Z1.4 Sampling Procedures and Tables for Inspection by Attributes.
- Z1.9 Sampling Procedures and Tables for Inspection by Variables for Percent nonconforming.

Many people are contributing to the review of these various standards. A heartfelt "thank you" to all of them.

## Awards Committee

Lynne Hare

Committee activity focused on three awards:

1. The William G. Hunter Award was presented to Ed Sylvestre at the 1998 FTC in Corning, NY. The committee is currently evaluating candidates for the 1999 award.
2. Five students received scholarships to attend the 1998 FTC. Applications for scholarships to attend the 1999 FTC are due August 1, 1999.
3. Six students were selected in 1998 from 26 applications to receive Ellis R. Ott Scholarships. Each student received a \$5000 grant. There are 30 applicants for 1999 grants, and evaluation of these candidates continues.

Continued on page 13

## COMMITTEE REPORTS

Continued from page 12

### Booth Activity

Our major objectives for the AQC Stat Division booth were:

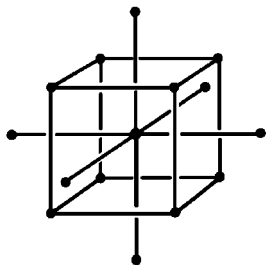
1. To feature/display the updated internet homepage.
2. To gather information regarding member needs.
3. To recruit more section liaisons.

To accomplish the first two objectives, we rented two computer systems. The webpage files were installed on these and visitors to the booth were able to visit the homepage and the Statistical Clearinghouse. This was very successful.

Due to technical problems we were unable to install on these computers a member questionnaire we developed. So we had to focus on people-to-people information gathering, which was quite successful. We gave out post-it notes, pens, newsletters, luggage tags, notepads, and we talked to hundreds of people. We recruited 20 new members; we recruited 41 new volunteers to be section liaisons; we recruited 3 new people who may fill some of our open volunteer positions.

We continue to seek section liaisons. We hope to have one for each section. If you or someone you know are interested, contact J.L. Madrigal at madrigal@byu.edu.

**Editor's note:** Some of these committee reports can be found in greater detail on the Stat Division homepage.



# MEMBERSHIP REPORT

## JUNE '98 TO APRIL '99

### 1. Nurturing Program - Section Liaison

This is the second year of the section liaison program. As part of this program, a new member orientation process was implemented. This includes a revised welcome letter, a four question survey (part of the welcome package), and a new member feedback measurement process. Responses from the new member survey indicate that many look forward to participating in informal meetings with local members of the division. We currently have 48 section liaisons in 23 states. Approximately 35% of them have given an abbreviated version of the Statistical Thinking presentation to their sections.

### 2. Member Survey #1: Training Preferences

At the tactical planning meeting in Corning, N.Y. (Fall '98), the Division Council agreed to survey members to identify their specific training needs at the section level. Information collected by Membership Chair J. L. Madrigal suggests that a very large majority of new members expect to receive some type of statistical training.

The sampling methodology divided the U.S. into strata and clusters. Each cluster comprised several regions, and within each cluster strata were randomly sampled proportional to strata size. A telephone survey yielded interviews with 203 members. Results indicate that 33% of members are very interested in local training, and 48% are somewhat interested. Four-hour short courses and one-day short courses are the preferred training formats.

The survey also examined the potential success of several new/developing products. The Statistical Clearinghouse web site receive the highest score of 4.53 (on a one to five scale), followed by the virtual academy (4.17), and web posting of past issues of the division newsletter (3.22). Both proposed book series scored highly with the "Performance" series at 3.71 and the "Concept" series at 3.88. Overall, web products generally received positive reviews. Recommendations from the survey: (a) use

four-hour short courses and one-day short courses as training formats; (b) instruct section liaisons to develop a list of local speakers; (c) put more effort into posting statistical information on the web page; and (d) improve the virtual academy on the web page.

### 3. Member Survey #2: Customer Satisfaction

Our second quarterly telephone survey, using proportional stratified cluster sampling (as above), dealt with member satisfaction. Note that the majority of non-response was due to people not being home to answer the telephone. Very few people actually declined participation in the survey. The survey researchers reduced non-response by sending faxes to some people who were difficult to contact, obtaining a 20% response from these faxes. Total number of responses: 235.

#### Results

A chi-square test for independence indicated no significant difference in responses for different geographical areas. Consequently the data are presented here without dividing into different geographic regions.

The first group of questions dealt with the Statistics Division. See Table 1. Respondents gave the division high overall ratings (58.7% excellent/very good and 34.3% good), with particularly high approval of "contributing to the advancement of statistical thinking".

The next group of questions asked members to rate the Statistics Division leaders. Please see Table 2. The first question asked whether the leaders make themselves available to members. Many respondents had "No Opinion" in response to this question. Of those who gave "No Opinion", many said they had not met any of the leaders and didn't feel confident in rating them. People commented that they feel distanced from the leaders. This is an area where improvement could be both helpful and necessary. Also, overall rating of the leaders indicates that 30.7% of members rate them as excellent/very good, 31.4 % as good, and 37.9% as fair/poor/no comment. These

Continued on page 14

# MEMBERSHIP REPORT

Continued from page 13

results indicate that we should be more proactive in leadership contact with members. It also suggests that the new member package is helpful to them.

## Reasons for Not Attending FTC

Members were asked whether they attended the Fall Technical Conference (22.64% said yes). Of those who said no, 33% gave time as a reason for not attending, 18% cited location, 12% cited scheduling, 18% cited cost, and 3% cited topics. Some less commonly cited reasons were: not in that field, not notified in time, work overload, new member of the division and not a priority.

## Top Three Division Activities

Members were asked to identify the most important division activities. 28% of respondents cited the newsletter, followed by the "How to .." series (15.4%), the FTC (8.7%), and the AQC (8.7%). Short courses and training came next.

## Comments and Suggestions

The last question asked if members had any comments/suggestions on improving the Division. Responses:

- \* the articles in the newsletter are excellent
- \* publish the newsletter on the website, keep the website updated with current division information

- \* more practical solutions to problems
- \* more personal contact and orienting new members, etc.
- \* too much theory and not enough practical applications
- \* research is very important
- \* more articles on statistical methods and tools in the newsletter
- \* more local organizations
- \* more application to healthcare laboratory settings
- \* make the meetings more accessible to members
- \* more advance notice of events
- \* more updated technology applications
- \* more information written for layman statisticians
- \* collaboration with universities
- \* shorter, smaller, regional seminars

## 4. Membership Dynamics/Retention

On July 1, 1998 we had 10,452 members. Over the previous eight years, an average reduction in membership of 13.37% (std. dev. 1.62%) is usually observed between September and October (when members are dropped for non-payment of dues in August). Most of that one-time loss has been recovered by the enrollment of new members over the course of the year. Consequently, net loss in membership has averaged about 3% per year over the past eight years. On April 30, 1999 division membership was 9,532, an 8.8% decrease from July 1. This suggests an end-of-year loss in the

6% to 7% range. Correspondingly, note that ASQ membership has declined 9.2% over the same time period.

Analysis of member dynamics over the last eight years suggests that a large proportion of new members quit the division within two years of joining. Of those who leave, about 30% (an average of 360 members) mention dissatisfaction with the division, high membership fee, or employer discontinuance of membership payment as reasons for leaving. These people represent an opportunity: convincing them that their membership is valuable could cause them to continue their membership. The section liaisons will play a significant role in this endeavor; they will be in direct contact with the members. The results of section liaisons' efforts may take at least three years before we see the fruits of their labors.

Several strategies could help increase member satisfaction with services and products offered by the Division. Some of them are: active section liaisons, chat rooms hosted by a division officer and/or council member via internet, and personal contact (telephone call, email, etc) by officers and division council members. Furthermore, the division homepage could be used to collect information about member needs, concerns and expectations. The virtual academy could also be used to strengthen links with members, and as a means of recruiting new members.

Question: The Statistics Division is:	Excellent/ V. Good	Good	Fair/Poor	No Op
Living its mission statement	38.7%	24.5%	3.5%	33.3%
Providing access to training and professional programs	39.1%	42.5%	13.8%	4.6%
Providing opportunities to meet statistics professionals	36.4%	32.5%	20.7%	10.3%
Contributing to advancement of statistical thinking	60.6%	27.9%	9.2%	1.2%
Keeping you current on the latest statistical tools	43.7%	48.3%	6.9%	1.2%
<b>Overall</b> , how would you rate the statistics division	<b>58.7%</b>	<b>34.3%</b>	5.9%	1.2%

**Table 1. Rating of the Statistics Division**

Question: How would you rate Statistics Division leaders in these areas	Excellent/ V. Good	Good	Fair/Poor	No Op
Making themselves available to members	36.4%	11.8%	11.5%	<b>40.2%</b>
Providing timely information on activities and events	37.6%	31.4%	16.1%	14.9%
Encouraging members to become actively involved	30.7%	24.5%	25.3%	19.5%
Orienting new members	44.7%	47.6%	4.2%	3.5%

**Table 2. Rating of Statistics Division Leaders**

# ANNUAL EVALUATION OF THE STATISTICS DIVISION

Robert Mitchell, Chair-Elect

## 1. Introduction

This is the seventh annual evaluation of the Statistics Division; no evaluation was written for the year July 1, 1997 - June 30, 1998. This evaluation "facilitates continuous improvement of the Statistics Division by measuring customer satisfaction and progress of the Division relative to McDermond guidelines and Statistics Division Vision, Mission, Strategy, Principles, Systems and Annual Tactical Plans" (Stat Division Operating Manual).

### Evaluation:

Recommendations from the 1996-97 Annual Evaluation were followed to develop an Operational Planning Calendar tying together activities from the GTC Key Dates calendar, the Stat Division Operating Manual, and Stat Division tactical plan project timelines. A number of system disconnects and lack of follow-through on several projects occurred during 1998-1999. An Officers' "Systems Improvement" meeting was held May 22, 1999 in Anaheim to identify and close the gaps.

### Upgrades:

1. Operating Manual underwent a comprehensive upgrade and was distributed via CD-ROM to every Council and Committee member.
2. Develop a tactical plan by the October 2000 FTC to internalize the new member Orientation process - to ground them in the Statistics Division culture, mission, vision, principles, and strategic plan.
3. Ensure that new Officers, committee members, and tactical plan leaders receive, read, and understand their respective responsibilities as per the Operating Manual.

## 2. Vision, Mission, Strategy and Principles

Our Vision is the desired end-state we strive to achieve, and our Mission is the reason for existence. The Strategy defines our customers and

markets; our Principles are rules to follow in pursuit of our vision and mission. A long-range planning session (LRP V) was held in Baltimore following the 1997 FTC. Our Mission, Vision, Principles, and Strategy were modified slightly to reinforce the Statistics Division's vision, "Statistical Thinking Everywhere." These are detailed on page two of this newsletter.

### Evaluation:

The revised five-year plan resulting from the Baltimore FTC LRP identified three Key Elements to focus on to achieve our mission and vision.

### Upgrades:

1. Several key positions in the Division infrastructure are still open. These need to be filled in order for us to achieve our 5-year plan.
2. Use the 2000 FTC as a working meeting to finalize incomplete tactical plans.
3. Place the revised M, V, S, P on our website. Include the Venn diagram in our Newsletters.

## 3. Customer Satisfaction

Division Membership continues flat or declines slightly. Quarterly membership surveys indicate a high level of satisfaction and exit interviews almost always give reasons other than dissatisfaction with the Statistics Division.

### Evaluation:

A "Member Nurturing" tactical plan was implemented to welcome new members and solicit their suggestions. Also, Section Liaison positions were created as a result of the "Become More Effective at the Local Level" tactical plan.

### Upgrade:

Good progress has been made on both tactical plans. A division Balanced Scorecard is being developed to better track leading indicators of Division health.

## 4. Systems

### 4.1 Infrastructure Renewal

Purpose: Continuously renew and improve the organizational structure of the Division.

Procedure: Past Chair is responsible.

### Evaluation:

We should include as many past chairs as possible in the AQC infrastructure meetings. This will give us a better pool of possible future division leaders. We should improve the process for responding to and utilizing members who volunteer. This should include metrics to track the quality of the process.

### Upgrades:

1. A New Member Orientation process has been developed.
2. A Volunteer Placement Coordinator position remains open.
3. Employer support to fund employee ASQ activities is declining. STAT will reimburse certain expenses to ensure that key committee members can attend the tactical planning sessions. To fund this increasing expense the Statistics Division Council is seeking new sources of revenue that will not increase member dues, yet provide value to members (e.g. regional Short Courses, new publications).

### 4.2 Conference Calls

Purpose: Facilitate communication among division leaders outside scheduled meetings.

Procedure: Monthly conference calls are held for division leaders.

### Evaluation:

These conference calls have been valuable for keeping division leaders communicating regularly. Division leaders will meet in July 1999 to revise the Operating Planning Calendar for the new fiscal year. Tactical Plan reports and Key Element status reports were added to these monthly conference calls.

Continued on page 16

# ANNUAL EVALUATION

Continued from page 15

## Upgrade:

1. Post the Operational Planning Calendar on an Officers-only page of the homepage.

### 4.3 McDermond Division Management Recognition Program

**Purpose:** Encourage divisions to focus on meeting the needs of their members, customers and ASQ.

**Procedure:** Documented in ASQ's policies and procedures. Chair is responsible for submitting the application.

## Evaluation:

Statistics Division achieved Level 3 (the top level) for 1996-97, 1997-98 and 1998-99. We will apply for Level 3 for the 1999-2000 fiscal year, and in subsequent years. We have created the McDermond Recognition Facilitator position to assist the chair in completing this application.

## Upgrade:

Follow the process.

### 4.4 Operating Manual

**Purpose:** Provide the information needed to run the division.

**Procedure:** Updated by incoming Chair-Elect in first quarter of the calendar year.

## Evaluation:

Most Operating Manual revisions focus on changes in job descriptions; other changes were minor. The Operating Manual was completely revised a year ago, including Committee Descriptions, job descriptions, updated LRP meeting minutes, Newsletter section, Youden Address, and Hunter Awardee information.

## Upgrades:

1. Put the Operating Manual on the Statistics Division webpage.
2. Put the Operating Manual on CD-ROM.

### 4.5 Tactical Planning

**Purpose:** To develop and implement tactical plans supporting the division strategy.

**Procedure:** Tactical Planning meetings are held at the AQC and FTC.

Follow-up meetings may be held as necessary.

## Evaluation:

The tactical planning meetings need to be balanced between providing time to work on tactical plans and providing time to review status and discuss new tactical plan candidates. We have made progress in reducing our tactical plans to 12-18 month schedules.

## Upgrades:

1. Split the AQC tactical planning meeting into two sessions. First, a review and evaluation session, when we review progress and evaluate direction. Second, a working session where tactical plan teams work on their specific plans.
2. Dedicate the FTC tactical planning meeting to working sessions, with a brief end-of-day wrap-up.

### 4.6 Annual Division Evaluation

**Purpose:** See Introduction

**Procedure:** See Introduction

## Evaluation:

This is the seventh annual evaluation. This evaluation is written by the out-going Chair-elect at the conclusion of the fiscal year. This person is then responsible for implementation as the incoming Chair.

## Upgrade:

See upgrade in Introduction.

### 4.7 Financial Requests

**Purpose:** Handle requests for donations in a manner consistent with our mission.

**Procedure:** Described in the Operating Manual.

## Evaluation:

Working well. Donations we make annually are now included in the budget.

## Upgrade:

Follow the process.

### 4.8 Maintenance System

**Purpose:** Ensure that action items resulting from meetings are completed.

**Procedure:** Keep a separate flip chart of action items at meetings. Review at end of meetings and assign responsibility and schedule. Include all action items in a single list and include in the minutes. Secretary will send out regular reminders.

## Evaluation:

Working well. Modifications have been made to the system. All action items, even those from conference calls, are captured on one list. This action-item list changes regularly as new items are added and others are completed.

## Upgrade:

Follow the process.

### 4.9 Budgets

**Purpose:** Ensure that division expenses are included in the annual division budget.

**Procedure:** Each year, committee chairs and tactical plan leaders provide a budget request to the Treasurer by April 15.

## Evaluation:

The process works well. However, we have had a deficit budget for several years.

## Upgrade:

Make certain we continue to add value to our members.

### 4.10 Reimbursement Policy

**Purpose:** Ensure that expenses are reimbursed in a standard manner.

**Procedure:** Section 4.10 of the Statistics Division Operating Manual describes the procedure.

## Evaluation:

The process works well. The reimbursement policy was modified to better explain the types of expenses that are or are not covered.

## Upgrade:

Follow the process.

# VOLUNTEERS – HELP WANTED

## CALL FOR SHORT COURSE CHAIRS

The Statistics Division seeks two volunteers to serve as Short Course Chairs for the 2000 AQC (Indianapolis) and 2000 FTC (Minneapolis).

### Responsibilities:

- With the advice and counsel of the Statistics Division Education Committee Chair and input from the STAT Officers and other members of the Division, select the topics and instructors for the Short Courses.
- Maintain all Division correspondence with the Short Course instructors, from the initial offer to the final thank-you, keeping appropriate records.
- Provide the Education Committee Chair and FTC Program Chair with all necessary information regarding the short courses (registration info, presentation abstract, speaker bio, program guide, materials reproduction, room set-up, audio-visual needs, etc).
- Work with the Treasurer to ensure that the instructors receive their travel expenses, materials costs, and honorariums in a timely fashion.
- Resolve any problems concerning the instructors.
- Attend the Short Course to facilitate and troubleshoot during the courses and obtain feedback for improvement.

Effective with the 2000 FTC in Minneapolis each of the FTC co-sponsors – ASQ Chemical & Process Industries Division, ASQ Statistics Division, and ASA Section on Physical & Engineering Sciences may sponsor a Short Course. The Statistics Division FTC Short Course Chair will coordinate the overall effort, working with the other organizations' Short Course Chairs.

For more information, or to volunteer for one of these two positions, complete the "Member Interest" form (from the web page) or notify Chair-elect Janice Shade ([shadej@nabisco.com](mailto:shadej@nabisco.com)).

## AQC 2000 VOLUNTEERS

Here's a complete list of volunteers for the May, 2000 Indianapolis AQC.

### Division-sponsored session mgr:

Mark Kiel  
Acme Steel  
(708) 849-2500 x 2164  
[MarkHK5409@aol.com](mailto:MarkHK5409@aol.com)

### Topic session mgr:

Gordon Booth  
(801) 476-9798  
[gordon@bootha.com](mailto:gordon@bootha.com)

George Marrah  
James Madison University  
(540) 568-6534  
[marrahgw@jmu.edu](mailto:marrahgw@jmu.edu)

### Paper reviewers:

Marcey Abate  
Sandia National Labs  
(505) 844-9424  
[mlabate@sandia.gov](mailto:mlabate@sandia.gov)

John Vandembemden  
(606) 384-3166  
[JFVIII@aol.com](mailto:JFVIII@aol.com)

Nancy Belunis  
Merck & Co., Inc.  
(908) 423-3423  
[belunis@merck.com](mailto:belunis@merck.com)

Babatunde Ayeni  
3M Co.  
(651) 736-9519  
[bjayeni@mmm.com](mailto:bjayeni@mmm.com)

Mike Thomas  
Merck & Co., Inc.  
(908) 423-3064  
[mthomas@merck.com](mailto:mthomas@merck.com)

Ram Sitaraman  
US West Communications  
(602) 351-5164  
[rsitara@uswest.com](mailto:rsitara@uswest.com)

## VOLUNTEER OPPORTUNITIES

The Statistics Division still has a few openings for volunteers to step forward and make a difference. If you've found yourself saying "The Stat Division should do....," then here's your chance to step forward and help do whatever you have a passion for. A volunteer organization is only as good as the people who volunteer. Here are some of the unfilled positions.

### Publications Committee:

Improving Processes... Series Editor;  
Understanding... Series Editor,  
Glossary Editor

### Program Committee:

Denning Applied Stats Liaison,  
Other Conferences Chair

### Education Committee:

Short Course Development Chair,  
Virtual Academy Editor

### Awards Committee:

McDermond Chair

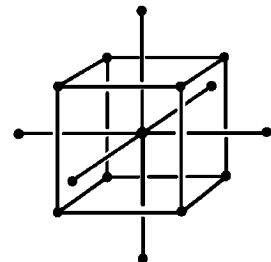
### Membership Committee:

Volunteer Placement Coordinator,  
Section Liaisons

### Regional Councilor:

Region 3

Volunteers should fill out a Member Interest Form (from the web page) and send a copy to Don Emerling, or simply an email message detailing your interests to Don at... [Don.Emerling@ryobi.com](mailto:Don.Emerling@ryobi.com)



# 43rd ANNUAL FALL TECHNICAL CONFERENCE APPLIED STATISTICS IN THE 21st CENTURY Houston, Texas October 14-15, 1999

The FTC, sponsored by ASQ's Chemical and Process Industries Division, the Section on Physical and Engineering Sciences of the American Statistical Association and the Stat Division of ASQ, will be in Houston this year. The Program Committee [Bob Brill, Solutia, Inc. (ASQ-STAT), Malcolm Hazel, Campbell Soup (ASQ-C&PID), and Connie Borrer, Arizona State Univ (ASA-SPES)] has put together an outstanding program (see the following page). Short Course Chair Cliff McCormick (McCormick Systems) has scheduled two excellent one-day courses for your consideration (see below). Local Conference Chair Jim Bigelow (TQM Consulting), Treasurer Brad Brown (Consultant), and Registrar Herb Monnich (H Monnich & Assoc) have registration and local arrangements well organized, and General Conference Chair Stephen Caffrey (Eastman Kodak), Chair-Elect of CPID, is coordinating everything.

**Local Arrangements:** The Conference will be held at the Wyndham Greenspoint Hotel. A block of rooms is being held at a special conference rate (\$125 single, \$135 double). Registration for the two-day conference has been held at \$190 (a great price for the best conference!), with \$150 the fee for one day. Student registration is \$75. The registration fee includes lunch, and refreshments morning and afternoon. Hotel and registration details will be in the Fall newsletter, and in the FTC brochure which will be mailed to all Stat Division members. A nontechnical or spouses program is scheduled for both days.

**Short Courses:** In the past, attendees have asked why we didn't schedule activities on Saturday so that attendees could have reduced airfares for Saturday stay-overs. Others commented that they'd like to attend both short courses, but couldn't when both were on Wednesday. We listened!! This year we scheduled one course for Wednesday, Oct. 13 (Principal Components Analysis and Projections to Latent Structures, presented by Nouna Kettaneh and Svante Wold) and Saturday, Oct. 16 (Measurement and Planned Experimentation in a Chemical Plant, presented by Lloyd Provost). Each course has a \$175 registration fee, including breaks and lunch. Courses meet from 8:30 a.m. to 5 p.m. They will be interactive and hands-on; be prepared to participate.

**Awards:** Four awards will be given:

1. Shewall Award, best presentation at 1998 FTC.
2. Wilcoxon Prize, best practical application paper.
3. Youden Prize, best expository paper (Technometrics).
4. Hunter Award, to someone with the characteristics of Bill Hunter, first Stat Division Chair.

Prof. Donald Bacon from Queens University has been invited to present the annual Youden Address. Don will impress you!

**Interaction:** At this conference Statisticians and non-statisticians communicate, interact and learn from each other. Discussion and interpretation take precedence over theorems and

proofs. Presentations are longer than 10 minutes to allow for substantive discussion and questions. The coffee/coke breaks are longer than three minutes to encourage interaction. And, the lively hospitality suite is a great place to meet and talk with speakers, officers and other attendees. The conference is renowned for its lively discussions. Plan now to come to Houston and join in the activities.

**Register early (by Sept. 15) to avoid the \$10 late surcharge.**

**FTC Student Scholarships:** The Statistics Division of ASQ is offering 5 grants to cover the cost of conference registration, meals (up to \$50) and hotel room for students who wish to attend the Fall Technical Conference.

Grants are available for currently enrolled undergraduate and graduate students of statistics and quality management. Travel costs will not be covered. Recipients may be asked to serve as room monitors for a conference session and will be asked to write a brief article about their experience for the newsletter.

Applicants should send a letter of interest, together with a letter of recommendation from a major professor, by August 1, to:

Nancy E. Belunis  
Merck & Co., Inc.  
One Merck Drive  
P.O. Box 100 WS3DE-20  
Whitehouse Station, NJ 08889

Notifications will be mailed by September 1.

Continued on page 19

# TECHNICAL CONFERENCE

Continued from page 18

## THURSDAY PROGRAM

PLENARY SESSION:

### ***Changing the Quality Control Paradigm.***

J. Stuart Hunter, Princeton Univ.

### ***Multivariate Process Monitoring Using Digitalized Spectra, Orthogonal Signal Correction, Wavelett Compression and PLS.***

Svante Wold and Nouna Kettaneh, Umeterics Inc.

### ***Adaptive Methods for Monitoring Fractionally Sampled Multiple Stream Processes.***

Jeffery Lanning, Air Force Inst. of Tech.

### ***The Use of Experimental Design Methodology and Multivariate Analysis in Product Development in the Food Industry.***

Narinder Singh Sahni

### ***Monitoring Dynamic Systems with the MEWMA.***

Christina Mastrangelo, Univ. of Virginia

### ***Control Charts for Low Rates of Process Nonconformance.***

Connie Borrer, Arizona State Univ.

### ***Using Graphical Hypothesis Testing for Assessing Capability with Cpm.***

N. F. Hubele, Arizona State Univ.

### ***A Multivariate Monitoring & Control of Batch Process Startup.***

Robin Wurl, Rutgers Univ.

### ***Control Charts for Calibration Equations.***

Rick Lewis, Solutia Inc

### ***Analyzing Constrained Experimental Designs Using Prediction Traces.***

Sharad Prabhu, SAS Institute

## LUNCHEON

### ***Quality 2000: New Challenges for New Opportunities.***

Charles R. (Ron) Asbury, President, ASQ

### ***Artificial Neural Networks: A Little Theory and Some Applications.***

Paul Luebbers, Solutia Inc

### ***Optimization Problems and Methods in Quality Control and Improvement, with discussion.***

W. Matthew Carlyle, Arizona State Univ.

### ***New Methods for Robust Regression.***

James Simpson, Florida State Univ.

### ***A Melange of Neural Network Applications.***

Glenn Mertz, Solutia Inc

### ***Predicting the Standard Deviation with Sparse Data.***

Joseph Conklin, U.S Bureau of Census

## FRIDAY PROGRAM

### ***Neural Networks for Chemometrics: An Evaluation.***

Dick De Veaux, Williams College

### ***Commercial Quality: The Next Wave in Statistical Thinking?***

Rekha Agrawal, GE Corporate R & D

### ***Comparing Randomization and a Random Run Order in Experimental Design.***

James Lucas, J. M. Lucas Assoc.

### ***Analysis of a Large Structure-Activity Data Set Using Recursive Partitioning.***

Andrew Rusinko III, Alcon Labs

### ***Computer Decision Support System for Quality Planning.***

Soumaya Yacout, Universite de Moncton

### ***Cross Functional Problem Solving, Using Properly Run Experiments in the Food Industry.***

Malcolm Hazel, Campbell Soup Co.

### ***Minimum Aberration Two-Level Fractional Factorial Split-Plot Designs.***

Derek Bingham, U. of Michigan

### ***A Consistent Approach to Inter-laboratory Precision.***

Russell Dillow, Chevron Chemical Co.

### ***Application of PLS to the Set-up and Control of Thermoplastic Forming.***

Robert Launsby, Launsby Consulting

### ***Bootstrapping in Controlled Calibration Experiments.***

David Rocke, U. California, Davis

### ***Gage R&R Studies for Two-Dimensional Data.***

Joseph Voelkel, Rochester Inst. of Tech.

### ***The Analysis of Designed Experiments Using Generalized Linear Models.***

Sharon Lewis, Arizona State Univ.

## LUNCHEON

### ***Who Counts? Statistics and the Census.***

Ray Waller, Executive Director, ASA

### ***A Comparative Analysis of Multiple Outlier Detection Procedures in the Linear Regression Model.***

James Wisnowski, Arizona State Univ.

### ***TTF vs TBF Reliability Analysis: Removing Doubt and Confusion.***

J. Bert Keats, Arizona State Univ.

### ***Are You Getting All the Essential Information from Your Experimental Results?***

Herman Sahrman, Effective Process Investigations

### ***Outliers and the Use of the Rank Transformation to Detect Active Effects in Unreplicated Experiments.***

Victor Aquirre, Instituto Tecnologico Autonomo de Mexico

### ***A Likelihood Approach to SPC.***

Moshe Pollak, Hebrew Univ. of Jerusalem

### ***Modeling and Experimentation for Multi-Response Optimization.***

Daniel Rand, Winona State Univ.

# MINI PAPER

## IMPROVING K-12 EDUCATION USING STATISTICAL THINKING: A CASE STUDY OF SCHOOL PRINCIPALS

Paula Brooks Sommer  
Institute for Standards in Quality Education  
Arlington, TX 76011

Dr. Charles Blanton  
Partners in Profound Knowledge  
Dallas, TX 75243

### SUMMARY

This session reports on a case study of teaching 15 principals how to improve school administration in small and rural schools using statistical thinking. The case study was performed in the Texas Woman's University's Principal's Academy and built on what we had learned in using statistical thinking in one middle school in downtown Dallas. The Academy met in five sessions of 1.5 days length from June 1998 to January 1999. The premise of the Academy was to teach three aspects of Dr. W. Edwards Deming's Theory of Profound Knowledge to reduce variation in schools.

What we learned was

1. Teaching statistical thinking to small and rural schools principals improves their abilities to manage the educational system.
2. Thinking statistically can begin with understanding and applying Dr. Deming's Theory of Profound Knowledge to reduce variation.
3. Reducing variation in a system reduces confusion, which in turn reduces conflict, complexity, chaos and cost.
4. Recognizing the 5 C's of systems suffering enables statistical thinking, defines the cause and effect plus enhances understanding of variation.
5. Having a systematic process for change reduces variation and improves the opportunity for effective change.

### BACKGROUND

The use of statistical techniques, such as statistical process control and experimental design, has long played an important role in U.S. business and industry. However, the effective integration of statistics into management science was hampered due to the ambiguity of how statistics fits into all aspects of management and all industries. In 1994 the Statistics Division of ASQ adopted the vision of having "statistical thinking everywhere." This led to the division

- \* Clarifying the barriers to having statistical thinking everywhere
- \* Defining statistical thinking
- \* Describing the overlap of statistical thinking and statistical methods
- \* Illustrating its deployment from strategic to managerial to operational level and addressing the issue of "how to teach others to apply statistical thinking"

In 1996, attendees to the Statistics Division's AQC session developed their ability to apply statistical thinking through an interactive scenario process. In 1997, the division presented the short course "How to Apply Statistical Thinking Effect-

ively." The course design was to better prepare participants to effectively apply statistical thinking and demonstrate improved results.

The Statistics Division has shared case studies for using statistical thinking with

- \* Cities
- \* Customer complaint processes
- \* Sales processes
- \* Personal applications of controlling diabetes
- \* Introductory college statistics courses

During the 1997 Divisional Strategic Planning session the area targeted for further study was the application of statistical thinking by teachers at the primary and secondary levels of education. This led to the pilot project at Pegasus Charter School in Dallas, Texas, which provides instruction to students in grades seven-nine. The project statement was "Develop a process for enabling teachers to understand and use statistical thinking to improve student performance."

The project defined with the chief education officer the project scope and method for measuring results. The scope was the performance in math and science of students in seventh to ninth grades. The prediction was through statistical thinking variation could be reduced, specifically the variation in the amount learned by students will be lowered.

We clarified operational definitions with chief education officer.

- \* Curriculum: body of knowledge, textbook, course of study
- \* Learning: process of translating information to actionable data
- \* Achievement: correct application of the studied concepts as measured by standardized tests
- \* Standardize learning process models: ORID and PAT

We selected as the key processes for the faculty to use to improve processes:

- \* PDSA: Plan-Do-Study-Act process with teachers' workshop on standardizing learning processes.
- \* ORID: Process for translating learning to action.
- \* PAT: Purpose, Activity, Timeline process for giving directions.

### WHAT WE LEARNED

- \* Among those in education, there is dissatisfaction with current results.
- \* There is a willingness to improve methods.
- \* Change requires dedication and commitment by all participants.

Continued on page 21

# MINI-PAPER

Continued from page 20

- \* Statistical thinking must be introduced in consideration of the system being impacted.
- \* Teaching statistical thinking requires time for the concepts to be assimilated and practiced in order for the teachers to become competent in the skill during the workshop.
- \* Follow-up on coaching is needed to support continued use of statistical thinking until it becomes habitual.

We concluded that

1. The process of re-channeling the thinking and habits of teachers requires more than one year of focused effort. It requires systemic support through all aspects of the organization.
2. Teachers need time to align their teaching materials to using statistical thinking in their delivery and assessment methods.
3. Variation can be reduced by applying the other three aspects of Profound Thinking, i.e., Theory of Psychology, Systems Thinking and Theory of Knowledge.
4. With teachers, start the transformation to using statistical thinking with teaching the Theory of Knowledge.

## BROADENING THE APPLICATION

In June 1998 we began, in conjunction with the Texas Woman's University, the process of teaching statistical thinking to 15 principals from across North Texas. This educational series was designed using statistical thinking. Three processes were selected for reducing variation and developing a systemic view of the educational system.

They are:

- \* the theory of knowledge (PDSA),
- \* theory of psychology (Change Process) and
- \* systems thinking (5 C's of Systems Suffering).

Then we put these processes to work in designing the series.

1. Our theory of improvement was: We believe that one way to provide quick and substantive transfer of knowledge of what works within a profession is to engage the professionals within that field in a common dialogue about what works best in their specialized area.
2. We used the Change Principle by determining what we wanted to change, what we want to change to and identify a coalition for change.
3. We used the 5 C's (confusion, conflict, complexity, chaos, cost) to improve our processes.

Principals attended five sessions of 1.5 days in length.

We reduced variation by having each session follow the pattern / process of

- \* Learn from the participants how their application of the theories based on last session worked and did not work,
- \* Introduce new knowledges, and
- \* Guide translation of new knowledges (using these three key processes) to application at these schools

The results were that the participants used these processes / key patterns to

- \* Understand the educational system as a system.
- \* Recognize cause and effect in their system.
- \* Systematically address primary core causes.

The evaluation by the participants was

1. to add three additional sessions beginning this fall
2. to be a reference for others to attend the sessions
3. to identify over 50 cohorts who they wanted to invite to learning the same information
4. to rate their learnings as follows (on a ten-point scale)
  - a. ability to recognize patterns 7.7
  - b. identify how patterns shape us 7.8
  - c. use data to clarify the pattern and focus 8.8
  - d. identify successful processes 8.8
  - e. use pattern recognition for systemic improvement 7.7
  - f. leverage the change in the system 7.8
  - g. take action that optimizes the whole system 7.7
  - h. align systems for measurable progress 7.5
  - i. move from reactive to anticipatory actions 7.7
  - j. aligning/harmonizing systems 7.6

## CONCLUSION

1. Teaching statistical thinking to small and rural schools principals improves their abilities to manage the educational system.
2. Thinking statistically can begin with understanding and applying Dr. Deming's Theory of Profound Knowledge to reduce variation.
3. Reducing variation in a system reduces confusion, which in turn reduces conflict, complexity, chaos and cost.
4. Recognizing the 5 C's of systems suffering enables statistical thinking, defines the cause and effect plus enhances understanding of variation.
5. Having a systematic process for change reduces variation and improves the opportunity for effective change.

## ACKNOWLEDGEMENTS

We thank Dr. Howard Stone, Dean of Education, Texas Woman's University for sponsoring and advising on the development of the series; Dr. Flora Roebuck, Professor TWU; Dr. James Monaco, Superintendent Aubrey ISD, Aubrey, Texas; and Doctoral Candidate Jan Meehan, TWU for their many contributions in teaching, advise, and support of the many details required for this endeavor.

## REFERENCES

1. Dr. Stephen Covey's First Things First, Chapter 13 "Empowerment from the Inside Out"
2. Dr. W. Edwards Deming's Out of the Crisis and The New Economy
3. Dr. Eli Goldratt's Five Layers of Resistance
4. Drs. David and Sarah Kerridge's "Dr. Deming's Cure for a Sick System"
5. Dr. Peter Senge's The Fifth Discipline

\*This is a summary of a report given at the ASQ Annual Quality Congress, Anaheim, CA, May 26, 1999.

# TUTORIAL

## Cpk Plots – An Application of Individuals Control Charts

Robert Mitchell, 3M Company

In a previous issue of the Statistics Division Newsletter, I introduced readers to a variety of Process Capability indices used today in industry. In this article I offer a case study on how an Individuals control chart is used to track Cpk as a means of measuring ongoing process improvement activities. Recall that Cpk is defined as:

$$Cpk = \text{minimum of } \left\{ \frac{\bar{X} - LSL}{3\sigma}, \frac{USL - \bar{X}}{3\sigma} \right\} \quad \text{where } \sigma = \text{process standard deviation}$$

Practitioners often forget that process capability indices are merely point estimates obtained by taking samples from a population. If one must report Cpk (many customers now require Cpk for key quality characteristics on suppliers' Certificates of Analysis), then one must understand the associated errors of sample size and other related limitations and constraints in estimating Cpk. First, Cpk should only be estimated for a stable process. A process lacking statistical control is not predicable. In such cases Ppk is the more correct estimate of process performance.

$$Ppk = \text{minimum of } \left\{ \frac{\bar{X} - LSL}{3s}, \frac{USL - \bar{X}}{3s} \right\} \quad \text{where } s = \text{sample standard deviation}$$

Second, Cpk (and Ppk) estimates of population capability assume the data come from a normal (or bell-shaped) distribution, with symmetrical specification limits about the target. Because process capability indices are determined from estimates of standard deviation, they are affected by sample size (degrees of freedom). As expected, the standard error of the estimate of Cpk decreases as the sample size increases.

It can be shown by use of the Chi-square distribution and Monte Carlo simulation techniques that a sample size (n) as small as 10 cannot be relied upon to give results of much practical value. Even when n is as large as 40 there is still substantial uncertainty in the estimator of Cpk. Table 1 provides an estimate of the 95% lower bound on the sample Cpk, for various known population (or lot) capabilities (assuming the data follow a normal distribution). Table 2 shows confidence intervals for Ppk.

**Table 1.** Approximate 95% lower CI for Cpk. (1)

		Sample Size Used to Estimate Cpk		
		30	50	75
True Cpk	1.00	0.72	0.79	0.83
	1.40	0.80	0.87	0.91
	1.50	1.12	1.21	1.26
	1.667	1.25	1.35	1.40

**Table 2.** Approximate 95% Confidence Interval for Ppk.\*

		True Ppk		
		1.00	1.33	1.67
Sample Size	30	.76-1.31	1.02-1.76	1.29-2.19
	60	.83-1.21	1.11-1.61	1.49-2.01
	120	.88-1.14	1.17-1.52	1.47-1.90

As Table 1 shows, a stable process possessing a "true" process capability of 1.00 could exhibit a sample Cpk value as small as 0.72, even when the sample size is as large as 30. Although not usually of interest, a similar approach would illustrate that the sample Cpk could be much larger than the population Cpk. These points are important to note with regards to shipment Certificates of Analysis (CoA) required by your customer. Small sample sizes could result in a "capable" shipment appearing to be not capable of meeting customer specifications, but only because the sampling variability allows the sample estimate of Cpk to be much smaller than the population or lot characteristic (referred to as 'producer's risk'). But also, an incapable shipment could 'appear' capable because the sampling variability allows the sample Cpk to be larger than the population or lot characteristic (referred to as 'consumer's risk'). Because the sampling distribution of the Cpk statistic is so variable it should not be used unless relatively large sample sizes (100~200) are obtained. If Lot Cpk is requested on a shipment CoA the supplier should pull in historical data to get the sample size (for Cpk estimates only) greater than 100. Similar variability in Ppk is illustrated by Table 2.

As with any process data, Cpk estimates are better understood and interpreted when they are plotted over time. To avoid the pitfalls of making decisions based on 2-point comparisons and of single sample variation the concepts of Statistical Thinking should be employed and Cpk values plotted on control charts. A graphical plot of Cpk assists in the visual summarization of process improvement (or deterioration). The following example illustrates both common cause variation in Cpk and special cause variation in Cpk.

### Case Study: Slit Roll Tab Control

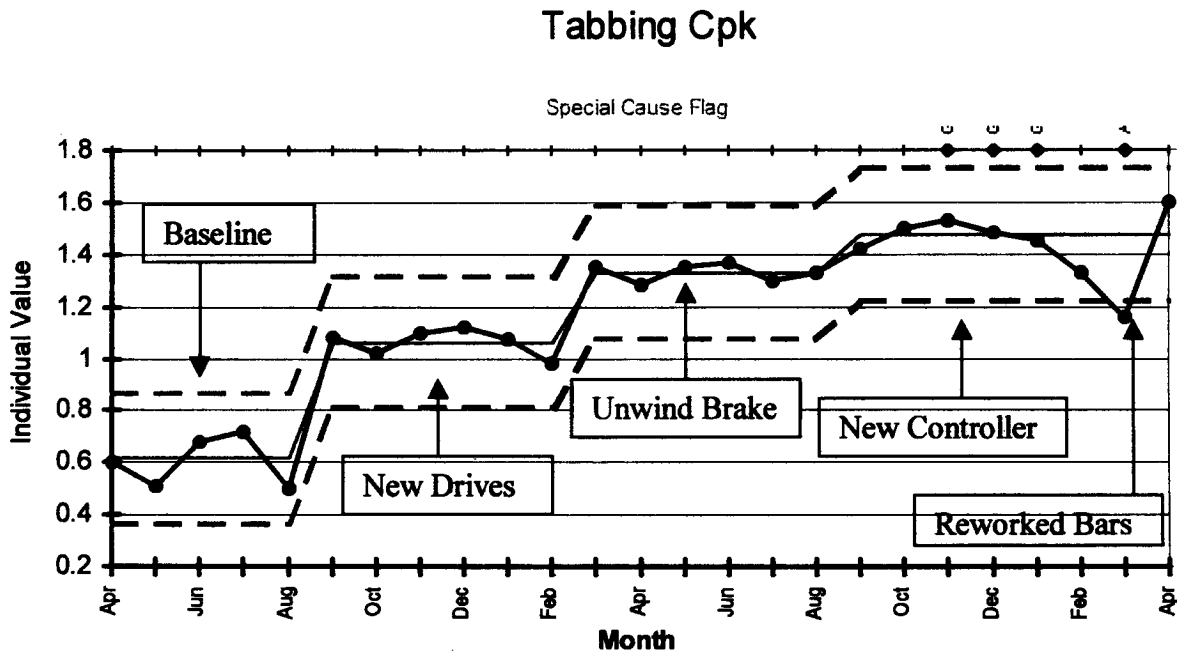
A key quality characteristic for the starter tab on a roll of office tape must be controlled to target, with minimal variation. Undertabbing results in a "flagged" tab which causes roll unraveling and strand entanglement in the automated conveying equip-

Continued on page 23

# TUTORIAL

Continued from page 22

ment; whereas, overtabbing causes end-user frustration due to difficulty starting the roll. In essence we have identified an Internal customer need for equipment efficiency, and an External customer need for ease of use. The parties agreed that this need might be 'summarized' by requiring a Cpk of 1.33 or greater. An Individuals control chart of Tabbng Cpk, (how well the starter tab is placed to the correct length on the roll of office tape), given below, shows the affect of slitting and winding process modifications over time. The "Individual Value" reported on the y-axis is the Cpk statistic calculated for the month. The monthly sample size was set at n=100 in order to minimize the effect of sampling variation in the estimate of sigma for the Cpk statistic.



The 3-sigma control limits on the Individuals chart are determined from the historical Moving Range of the monthly averages. The limits were then "fixed" about the process mean. The centerline was adjusted only after we had determined that the process shift was indeed attributed to our process modifications, and only after we were comfortable that the change was permanent. (Remember we are collecting a minimum 100 Tab Length measurements per month). During the first five months of charting this key quality characteristic of the tabbing process was in-control (predictable) but not capable of meeting tab length specifications, i.e. Cpk was less than 1.0. A cross-functional team of operator, maintenance, and process engineers was formed to improve the tabbing capability. Possible causes for the tabbing variation were brainstormed and prioritized. Process Capability was plotted over time as process modifications were implemented. The monthly chart of Cpk clearly illustrates that the installation of new drives raised the process capability from the 0.6 vicinity to the 1.0 vicinity, and we knew that this special cause change (Cpk values outside the former limits) was 'significant'. Similarly, the next change (unwind brake) was illustrated to have raised the process capability from the 1.0 vicinity to the 1.3 vicinity; and the new controller raised it further to the 1.4 vicinity. The most recent change (reworked bars) is still being evaluated. Note that the decisions as to whether Cpk has improved and whether it meets the 1.3 standard are not based on a single value but rather on a collection of values, and the graphical representation helps visualize these judgements.

Through the use of this "process behavior chart" on Cpk we have been able to quickly and easily display the effect of various process changes on process capability, and to illustrate whether these process changes resulted in significant changes in Cpk (special cause) or merely random changes in Cpk (common cause). However, although the Individuals control chart of Cpk values helps illustrate process improvements over time and differentiate Special cause from Common cause variation month to month, it does not show the short-term underlying stability of the roll tabbing process. In other words, though a Cpk value can be calculated, is the underlying process stable and in a state of statistical control (a requirement of Cpk)? Tab Length X-bar and R charts were maintained by production operators in order to verify that the new process was stable, following each of the above process changes. The estimates of Cpk were then summarized monthly by the process engineer and used in the above chart.

## SUMMARY

Cpk values are estimates (statistics) calculated from a sample and used to estimate a population characteristic. These estimates are subject to variation (sampling variability). The larger the sample used to estimate Cpk, the smaller the variation in that estimate. A simple control chart can be used to illustrate this 'random variability in Cpk', and to help us identify when process changes have resulted in significant improvements in process capability.

### Reference:

(1) Franklin, L. A. and Wasserman, G. S., "Bootstrap Lower Confidence Limits for Capability Studies", JQT, Vol. 24 No. 4. and Quality Assurance for the Chemical and Process Industries, 2nd edition, (ASQ Quality Press).



**STATISTICS DIVISION  
AMERICAN SOCIETY FOR  
QUALITY**  
c/o Ralph St. John  
Dept. of A.S.O.R.  
B.G.S.U.  
Bowling Green, OH 43403-0267

**Non-Profit Org.**  
U.S. Postage  
**PAID**  
Cedarburg, WI  
Permit No. 199

The ASQ Statistics Division Newsletter is published quarterly by the Statistics Division of the American Society for Quality.

All communications regarding this publication, **EXCLUDING CHANGE OF ADDRESS**, should be addressed to:

Ralph St. John, Editor  
ASQ Statistics Division Newsletter  
Dept. of Applied Statistics & O.R.  
Bowling Green State University  
Bowling Green, OH 43403-0267  
Phone: (419) 372-8098  
Fax: (419) 372-2875  
Email: rstjohn@cba.bgsu.edu

Other communications relating to the Statistics Division of ASQ should be addressed to:

Don Williams  
2515 Jamestown Lane  
Denton, TX 76201  
(940) 243-1147  
d.r.williams@asqnet.org

Communications regarding **change of address** should be sent to ASQ at:

American Society for Quality  
P.O. Box 3005  
Milwaukee, WI 53201-3005

This will change the address for all publications you receive from ASQ including the newsletter. You can also handle this by phone (414) 272-8575 or (800) 248-1946.

### UPCOMING NEWSLETTER DEADLINES

Issue	Vol.	No.	Due Date
Fall '99	18	3	Aug. 15, 1999



Printed on Recycled Paper