

Message from the SPES Chair

Russell V. Lenth, SPES Chair, The University of Iowa

When writing an article like this, it is good to find a source of inspiration. My inspiration comes from a recent article by long-time SPES member Rob Easterling. The article leads off the February 2010 issue of *The American Statistician*, and is titled “Passion-Driven Statistics.” I highly recommend this article to all readers.

In the article, Easterling explores the reasons why, at social gatherings, people often get pained responses when they find out that you are a statistician. The conversation turns to a recount of the dumb (or hard, or irrelevant, or poorly taught, or boring) statistics course that s/he had to take in college. Rob suggests a couple of snappy comebacks, but mostly expounds on why this reaction is valid, citing examples such as a textbook problem where a shoe-store owner wants to test a hypothesis about the median size of women’s shoes sold. There are so many good statistical questions that a shoe-store owner might ask (for example, having to do with inventory issues); but who cares about the median size? If we teach statistics using dumb examples, it’s no wonder that students take away the message that statistical methods have little use or relevance.

Easterling also quotes the late Carl Marshall: “The nice thing about statistics is that the nouns may change, but the verbs stay the same.” In this, the verbs are the things you do—consider how data were collected, develop models, explore, fit and analyze—whereas the nouns are the contexts in which the methods are applied. The shoe-store owner deals with nouns such as shoes, sales, payrolls, and inventories; and these are the things that matter to her. Starting with the nouns and finding suitable verbs is the way to put passion in what we do, because then we are doing things that matter to somebody.

As an aside, a statistician who begins his career working in the chemical industry, and then moves to a job in aerospace engineering, should properly be respected as a “re-nouned” statistician.

So now I will call your attention to the fact that we in SPES belong to an ASA section that is organized around nouns: physical and engineering sciences. (And the same is true of our partner in this newsletter, quality and productivity; and of the Pillsbury doughboys that we both prize so much at the annual joint business meeting.) Many other ASA sections are verb-based: survey methods, Bayesian statistics, etc. I do not mean to put down put down those verb-based sections, and in fact I belong to several of them (education, computing, graphics); but we noun-based sections are where the passion lies! And with that comes additional responsibility to share it so that others can see it and benefit.

And I am here to tell you that I think we do a pretty good job of highlighting those nouns and showing what verbs are best. We are closely connected with one of the very best noun-based journals, *Technometrics*, and we co-sponsor two outstanding noun-based conferences, the Fall Technical Conference and the Spring Research

What’s Inside . . .

SPES

Message from the SPES Chair	1
2009 SPES Awards for Outstanding Presentations and Poster Presentations	3
Invited Sessions for SPES Program at JSM 2010	6
SPES Short Course at JSM 2010	7
Announcing the Roundtable Luncheons at JSM 2010	7
Volunteers Needed for SPES Presentation and Poster Awards Program at JSM 2010	8
The Marquardt Memorial Industrial Speakers Program: A New Chapter in an Old Story	8
2010 SPES Officers Directory	14

Q&P

Message from the Q&P Chair	2
2010 Natrella Scholarship Winners	3
Q&P Program at JSM 2010	4
Q&P Roundtables at the 2010 Joint Statistical Meetings	6
Q&P Program at FTC 2010	9
Student Competition: Can You Improve a Process?	10
2010 Q&P Officers Directory	16

Both

54th Annual Fall Technical Conference	8
Understanding Logistics in System Analysis	11

Remember: You can always find the most recent issue of this newsletter, along with archives back to 1996, on the SPES and Q&P home pages:

SPES: www.amstat.org/sections/spes

Q&P: www.amstat-online.org/sections/qp

Conference, as well as offer excellent noun-based technical sessions at the Joint Statistical Meetings.

Another way we can spread the passion is through our Marquardt Industrial Speakers program. This program provides a way for universities to arrange for practicing statisticians in industry or government to come to campus and talk to students, and to fund their travel. It is incredibly valuable to students for exactly the reasons that Easterling describes in his article. It can also serve a subversive role as well, in attracting their professors' attention to some application-areas that can stimulate new research and liven-up their teaching. I know from my own experience how stimulating it is to bring in one of these speakers. For all its wonderful benefits, this program has been under-used in recent years. If you are interested in arranging for an industrial speaker, or in offering yourself as a speaker, please contact our Marquardt Industrial Speaker chair, Mary Leitnaker at mleitnaker@utk.edu.

We have some other good things going. My predecessor, Tom Loughin, did a great job in mobilizing people and getting moving in some new directions. We are trying to reach out more to encourage people to join our section, or to renew their membership. With so many ASA sections, there is a lot of competition for section memberships. We now have a LinkedIn group for SPES and a SPES forum (get a LinkedIn ID, and search for "SPES"). We will try to get some webinars going on topics of mutual interest. We are encouraging Marquardt speakers and others to promote SPES membership to students. We face a continuing struggle to be counted correctly and for mailing lists to include all members (our joint SPES/Q&P option causes some complications). And we want to do more things to reach out to students. Tom has laid the groundwork, and I hope to keep the momentum going.

If you have any ideas for improving section offerings, please contact me—my e-mail address is russell-lenth@uiowa.edu. I look forward to seeing you at SRC/QPRC in Gaithersburg, JSM in Vancouver, FTC in Birmingham; and in general to another great year in the history of the Section for Passion in Everything Statistical—SPES. ■

Message from the Q&P Chair

Mark Bailey, Q&P Chair, SAS Institute Inc.

Thank you for reading my mid-year report about our Section. It seems that everyone is busier these days, if that is possible, but we still manage to operate as a team to support Q&P programs and conferences for you. Perhaps you have an idea for a new member benefit or a new feature for one of our conferences. Please let me know about it!

Q&P Webinar Series

Past Chair Connie Borrer began a special Webinar series for topics of interest to Q&P members. These presentations were open to all ASA members but the focus was on Q&P and Section members received a discount on the registration fee. This series continues but we need your help and ideas. What topics would you like to learn about? What speakers would you like to hear from? Would you like to get involved in the production of this series? Please let me know!

Q&P Web Site

The original Section Website is still available at <http://www.amstat-online.org/sections/qp/> and maintained with up to date information and materials. We are in the process of migrating to a new site hosted within the new ASA Community. This way, our Section will be integrated into the full features of the main site and offer a consistent and cohesive experience for you. Since this site is a new development, it has not fully taken shape. What features would serve you best? What uses would build the community of Q&P members? What kinds of discussions and information would be valuable? Please let me know!

Joint Research Conference

The Quality and Productivity Research Conference occurred together with the Spring Research Conference this year as the Joint Research Conference. The National Institute of Science and Technology in Bethesda, MD hosted the JRC, on May 25-27. The program committee, consisting of Will Guthrie, I-Li Lu, John Lu, Dan Samarov, and Galit Shmueli, with additional help from the ASA and NIST, produced an outstanding and exciting program this year. The topics spanned many areas of interest such as design of experiments, reliability analysis, spatial statistics, advanced models, and Bayesian statistical process control. In addition, Dr. Stephen Feinberg, Dr. Vijay Nair, Dr. Diane Lambert, and Dr. Bradley Jones gave four special presentations. The pre-conference short course was "From Statistical Consultant to Effective Leader", presented by Ronald Snee and Roger Hoerl. The Mary G. and Joseph Natrella Scholarships were presented, as reported elsewhere in this issue.

Joint Statistical Meetings

The Q&P Section will sponsor or co-sponsor many events at the JSM on July 31 through August 5 in Vancouver, BC. A strong team of Dana Krueger, Programs Chair, and Theresa Utlaut, Programs Chair-Designate put the program together. Please see their message elsewhere in this issue. This program included invited sessions, contributed sessions, and breakfast and lunch roundtables. The social event of the JSM is the SPES/Q&P Mixer with refreshments and a raffle for door prizes donated by our many supportive exhibitors following a short business meeting.

Fall Technical Conference

The 54th Fall Technical Conference will be held on October 7-8 in Birmingham, AL, this year. The theme this year is "Statistics and Quality: The Engines of Success". The Plenary Speaker will be Dr. William Woodall of the Virginia Tech, who will give "An Unauthorized History of Quality and Statistics". The pre-conference short courses will be "Data Mining" by Julia O'Neill and Matthew Wiener and "Acceptance Sampling" by Dean Neubauer. The post-conference short courses will be "Logistic Regression Analysis" by Richard Lynch and "Experiences and Pitfalls in Reliability Data Analysis and Test Planning" by William Meeker.

So, you can see what I mean when I claim that we have been busier than ever. But we are never too busy to listen to members with ideas, suggestions, or questions about their Section. Please contact me at mark.bailey@sas.com and let us know! ■

2010 Natrella Scholarship Winners

Keith Eberhardt, Natrella Scholarship Selection Committee Chair



Jeffrey Boone



Laura Freeman

The Quality and Productivity Section awarded two Mary G. and Joseph Natrella Scholarships at the 2010 Joint Research Conference on Statistics in Quality, Industry and Technology, which was held on May 25-27 at the National Institute of Standards and Technology in Gaithersburg, MD. The scholarships are sponsored by the ASA Natrella Scholarship Fund and the Quality and Productivity Research Conference. Each winner gave a research presentation at the conference and received a \$3000 scholarship, plus \$500 for travel expenses and complimentary registration for the conference and the pre-conference short course.

The recipients for 2010 are: **Jeffrey Boone**, a PhD candidate in the Applied Statistics Program at the University of Alabama, and **Laura Freeman**, a PhD candidate in the Department of Statistics at Virginia Tech.

Mr. Boone was recommended for the award by Professors Subhabrata Chakraborti and Marcus Perry. His presentation at the conference was entitled "Multivariate Nonparametric Shewhart-Type Control Charts." Ms. Freeman was recommended for the award by Professors Geoffrey Vining and Jeffrey Birch. The title of her presentation was "Reliability Data Analysis for Designed Experiments."

The winners were chosen for their outstanding teaching, community service, mentoring, leadership, scholarship and commitment to the pursuit of quality improvement through the use of statistical methods. ■

2009 SPES Awards for Outstanding Presentations and Poster Presentations

Allison Rajakumar, SPES Awards Chair, The Lubrizol Corporation

The Section on Physical and Engineering Sciences is pleased to announce the results of its annual competition for contributed papers presented at the 2009 Joint Statistical Meetings in Washington, D.C. The outstanding presentation awards encourage excellence in presentation and have helped to raise the SPES contributed sessions to a higher level of quality. All awards are based on audience evaluations of each speaker. Each year, SPES recognizes the outstanding presentation among all papers contributed to the SPES sponsored session; the runner-up and honorable mentions are also recognized. Winners receive a certificate recognizing their accomplishment as well as a cash award. The awards for the 2009 JSM will be presented at the SPES mixer during the 2010 meetings in Vancouver, British Columbia. The 2009 awards go to:

Outstanding Presentation Award to David M. Steinberg, Tel Aviv University, for the SPES contributed paper "Sequential Design of Experiments for GLMs." The paper presented is joint work with Hovav Dror, Tel Aviv University.

Runner-up Outstanding Presentation Award to Herbert Lee, University of California, Santa Cruz, for the SPES contributed paper "Treed Gaussian Processes for Computer Model Emulation." The paper presented is joint work with Robert B. Gramacy, University of Cambridge.

Honorable Mention to Morris H. Morgan, Hampton University, for the SPES contributed paper "Statistical Response of Chaotic Networks to Structured Noise." The paper presented is joint work with Carolyn B. Morgan, Hampton University.

Honorable Mention to Christopher Tong, Merck & Co., Inc., for the SPES contributed paper "Simple Linear Regression When Both Variables Are Random." The paper presented is joint work with Shubing Wang, Merck & Co., Inc.

Honorable Mention to Sanjib Basu, Northern Illinois University, for the SPES contributed paper "A Unified Competing Risks Cure Rate Model for Failure Data."

Honorable Mention to Ta-Hsin Li, IBM T. J. Watson Research Center, for the SPES contributed paper "A Robust Nonlinear Method for Spectral Analysis."

In an effort to encourage excellence in the JSM poster program, SPES began the outstanding poster presentation awards program at JSM 2007. The Section on Physical and Engineering Sciences is pleased to announce the results of its third competition for contributed posters presented at the 2009 Joint Statistical Meetings in Washington, D.C. As with the paper presentation awards, all awards are based on audience evaluations. The awards will be presented to the winners at the SPES mixer during the 2010 meetings. The 2009 awards go to:

Outstanding Poster Presentation Award to Maria Weese, The University of Tennessee, for the SPES contributed poster "The Use of T-Squared Control Charts for Process-Driven Studies."

Runner-up Outstanding Poster Presentation Award to Yang Yang, University of Michigan, for the SPES contributed poster "Inference with Censored Degradation Data." The poster presented is joint work with Vijay Nair, University of Michigan.

Honorable Mention to Ritaja Sur, University of Maryland, for the SPES contributed paper "Statistical Analysis of Eye Movement Data." The poster presented is joint work with Benjamin Kedem, University of Maryland.

Congratulations to all the winners!

Start preparing now for JSM 2010 in Vancouver, B.C. and you may see your name listed among the SPES Outstanding Presentation Awards or SPES Outstanding Poster Awards winners next year. Good luck to all the 2010 SPES contributed papers and posters presenters. ■

Q&P Program at JSM 2010

Dana C. Krueger, Q&P Program Chair, Kansas State University



The 2010 Joint Statistical Meetings are fast approaching, and I hope you are excited about traveling to Vancouver! The Quality & Productivity Section

this year is offering a strong program with two invited panel sessions, two topic-contributed sessions, and five contributed sessions. In addition, the section is co-sponsoring a number of sessions that may be of interest to our members that have been coordinated by other sections of ASA. You can find all the Q&P sponsored and co-sponsored sessions by searching the online JSM program by sponsor at <http://www.amstat.org/meetings/jsm/2010/onlineprogram/index.cfm?fuseaction=main>. Please be looking at the program now to plan which sessions may be most beneficial for you to attend.

Invited Sessions

On Tuesday, August 3, at 2:00 p.m., an invited panel organized by Dana C. Krueger will discuss “Future Developments in Experimental Design” (Session 388). Douglas C. Montgomery of Arizona State University, Peter Goos of the University of Antwerp, and Rachel T. Johnson of the Naval Postgraduate School will serve as panelists that will focus their remarks on recent and future development in the area of experimental design, including optimal designs for linear and non-linear applications, split plot designs, computer experiments, and choice experiments. Time has been allocated for discussion with the audience as well. Di Michelson will be chairing the session.

On Wednesday, August 4, at 8:30 a.m., another exciting invited panel is planned. This session, organized and chaired by Martha M. Gardner of GE Global Research, is entitled, “Statistical Engineering: An Idea Whose Time Has Come? A Discussion in Honor of Gerald Hahn's 80th Birthday” (Session 450). Panelists Ronald Snee of Snee Associates, LLC, Geoff Vining of Virginia Tech, Bill Parr of China Europe International Business School, and Roger Hoerl of GE Global Research will discuss the potential root cause of some of the problems our profession faces, suggesting that our society, especially in the quality arena, may need us to function more as an engineering discipline, rather than solely as a pure science.

Topic-Contributed Sessions

Q&P is pleased to sponsor two topic-contributed sessions this year at JSM. On Sunday, August 1, at 4:00 p.m., “metRology: A New R Package for Applications in Measurement Science,” organized by William F. Guthrie of NIST and chaired by Daniel Samarov, also of NIST, will include the following papers:

- **metRology - a new R package for measurement science** —Stephen L.R. Ellison, Laboratory of the Government Chemist
- **Interlaboratory studies and the metRology package in R** —James H. Yen, National Institute of Standards and Technology

- **Using R for Assessing Measurement Uncertainty** —Hung-Kung Liu, National Institute of Standards and Technology; William F. Guthrie, National Institute of Standards and Technology; Antonio Possolo, National Institute of Standards and Technology; Stephen L.R. Ellison, Laboratory of the Government Chemist
- **An Excel Interface for Functions in the metRology Package** —William F. Guthrie, National Institute of Standards and Technology; Hung-Kung Liu, National Institute of Standards and Technology

The session also includes Connie M. Borrer, Arizona State University, as a discussant and will be followed by audience discussion.

On Monday, August 2, at 10:30 a.m., a session organized by Samiran Ghosh, Indiana University Purdue University, and chaired by Ranjan Paul, Boeing, entitled “From the Parameter Estimation to Reliability Specification in Some Nonstandard Situations Related to Time-to-Event Modeling” will include five papers and time for floor discussion. This session will feature papers on:

- **Comparison of cure rate models in competing risks framework** —Sanjib Basu, Northern Illinois University; Suchitrita Sarkar, Northern Illinois University
- **An Imputation Based Approach for Parameter Estimation in the Presence of Ambiguous Censoring with Application in Industrial Supply Chain** —Samiran Ghosh, Indiana University Purdue University
- **Computational Issues in Bayesian Design of Life Tests** —Refik Soyer, The George Washington University
- **Reliability models for single repairable systems and some non-standard inference** —Ananda Sen, University of Michigan
- **Inference for Variable-Stress Experiments** —Nandini Kannan, The University of Texas at San Antonio

Contributed Sessions

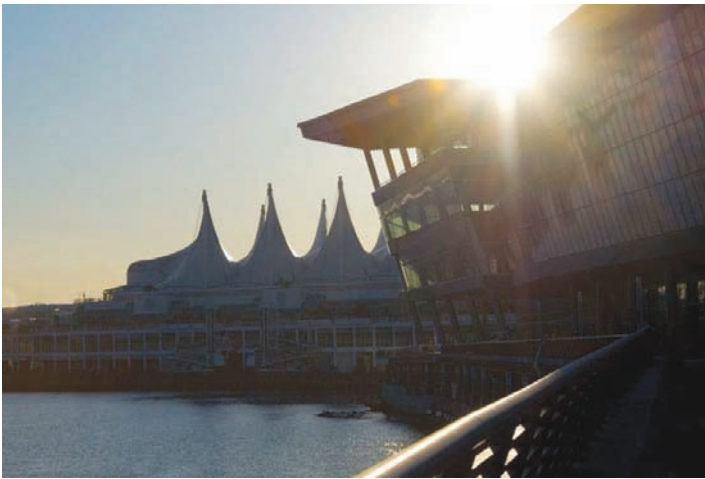
Q&P also had some very good contributed submissions that were organized into five sessions. The titles of the presentations and the authors' names and affiliations follow:

- **Productivity, Capability, and Tolerance Intervals**
 - o Sun, 8/1/10, 4:00 PM - 5:50 PM
 - o **Improving Productivity Using Lean Six Sigma** —Ayodele O. Mobolurin, Howard University; Mohammad A. Quasem, Howard University
 - o **Productivity Improvement of Three Stations and a Single Buffer Model with Continuous Materials Flow** —Mohammad A. Quasem, Howard University
 - o **Developing New Capability Indices for the Positional Tolerance of a Multidimensional Machining Process** —Chun-Yi Lee, National Chiayi University; Jeh-Nan Pan, National Cheng Kung University



Vancouver, British Columbia, site of the JSM 2010.

- o **Process Capability Analysis Chart for a Product with Bilateral Specifications** —Jose Alberto Vargas, Universidad Nacional de Colombia; Ruben D. Guevara, Universidad Nacional de Colombia
- o **A Simple Approximate Procedure for Constructing Binomial and Poisson Tolerance Intervals** —Yanping Xia, Southeast Missouri State University; Kalimuthu Krishnamoorthy, University of Louisiana at Lafayette
- o **Tolerance Intervals for One-Way Random Effects Models Based on Modified Signed Log-Likelihood Ratio** —Gaurav Sharma, University of Maryland Baltimore County; Thomas Mathew, University of Maryland Baltimore County
- **Statistical Process Control I**
 - o Mon, 8/2/10, 10:30 AM - 12:20 PM
 - o **Monitoring Profile Based on a Linear Regression Model with Correlated Errors** —Tsung-Chi Cheng, National Chengchi University; Su-Fen Yang, National Chengchi University
 - o **A Study of SPC Under Run-to-Run Feedback Control** —Shui-Pin Lee, Ching Yun University
 - o **Stability Analysis of Double Multivariate EWMA Controller Under Dynamic Models** —Chien-Hua Lin, Providence University; Sheng-Tsaing Tseng, National Tsing-Hua University
 - o **A Nonparametric EWMA Control Chart for Location Based on the Sign Statistic** —Marien Alet Graham, University of Pretoria; Schalk William Human, University of Pretoria; Subhabrata Chakraborti, The University of Alabama
 - o **G-EWMAG Control Chart for High-Quality Processes** —Chang Wook Kang, Hanyang University; Jae-Won Baik, Hanyang University; Hae-Woon Kang, Hanyang University; Min Song, Hanyang University
 - o **Bayesian Control Charts for Attributes** —Natalia Rojas-Perilla, Universidad Nacional de Colombia; Piedad Castro-Torres, Universidad Nacional de Colombia; Jose Alberto Vargas, Universidad Nacional de Colombia
- o **Q Charts for the Exponential Distribution** —Schalk William Human, University of Pretoria; Subhabrata Chakraborti, The University of Alabama
- **Statistical Process Control II**
 - o Wed, 8/4/10, 8:30 AM - 10:20 AM
 - o **Use of CUSUM Control Charts When Population Size Changes Over Time** —J. Brooke Marshall, Merck Research Laboratories; Dan J. Spitzner, University of Virginia
 - o **Phase II Monitoring of Covariance Stationary ARMA Processes** — Marcus Perry, University of Alabama; Gary Mercado, The University of Alabama
 - o **A Nonparametric Change Point Model for Multivariate Phase II Statistical Process Control** —Mark David Holland, University of Minnesota; Douglas Hawkins, University of Minnesota
 - o **A Multivariate Control Chart Increases in Process Dispersion** —Chia-Ling Yen, National Chiao Tung University; Jyh-Jen Horng Shiau, National Chiao Tung University
 - o **On Monitoring Process Variance with Individual Observations** —Arthur Yeh, Bowling Green State University
 - o **Comparisons of estimators of process standard deviation in constructing Shewhart control charts with unequal subgroup sizes** —Nien Fan Zhang, National Institute of Standards and Technology; Per Winkel, Copenhagen Trial Unit
- **Experimental Design: Applications and Advances**
 - o Thu, 8/5/10, 8:30 AM - 10:20 AM
 - o **Single-Stage Analysis of Means Under Heteroscedasticity** —Miin-Jye Wen, National Cheng Kung University; Yi-Hsuan Tu, National Cheng Kung University; Tsai-Hsiang Hung, National Cheng Kung University
 - o **Statistical Analysis of RFID Tag Readability on a Conveyor Belt Using Factorial Design** —Lash Mapa, Purdue University Calumet; Gokarna Aryal, Purdue University Calumet
 - o **Tests for High-Dimensional Regression Coefficients with Factorial Designs** —Ping-Shou Zhong, Iowa State University; Song X. Chen, Iowa State University/ Peking University
 - o **Using Weak and Strong Heredity to Generate Weighted Design Optimality Criteria for Response Surface Designs** —Philip Turk, West Virginia University; John Borkowski, Montana State University; Boonorm Chomtee, Kasetsart University
 - o **Some Recent Advances on Quaternary-Code Designs** —Frederick Kin Hing Phoa, Academia Sinica



Vancouver Convention Centre

- o **A Closer Look at Dorian Shainin's Variable Search Technique** —Tirthankar Dasgupta, Harvard University; C.F. Jeff Wu, Georgia Institute of Technology; Nagesh Adiga, Georgia Institute of Technology
- o **Optimal Design for Multifactor Life-Testing Experiments** —Steven E. Rigdon, Southern Illinois University Edwardsville; Douglas C. Montgomery, Arizona State University; Rong Pan, Arizona State University; Connie M. Borrer, Arizona State University West
- **Reliability Analysis and Yield Modeling**
 - o Thu, 8/5/10, 10:30 AM - 12:20 PM
 - o **Optimal age-replacement time with minimal repair based on cumulative repair-cost limit for a system subjected to shocks** —Shey-Huei Sheu, Providence University; Chin-Chih Chang, Providence University; Yu-Hung Chien, National Taichung Institute of Technology
 - o **Bayesian Methods for Supercomputer Reliability Data** —Sarah Michalak, Los Alamos National Laboratory; Todd Graves, Los Alamos National Laboratory; Lori Pritchett-Sheats, Los Alamos National Laboratory
 - o **Bayesian Analysis of Multistage Process Yields** —Patrick J. Gaffney, ImClone Systems; Alan Richter, ImClone Systems
 - o **Hierarchical Approach to Yield Modeling: Applications of GLMs** —Christina Mastrangelo, University of Washington
 - o **Random Contamination of Semiconductor Materials** —Bernard Harris, University of Wisconsin
 - o **Field-Failure and Warranty Prediction Based on Auxiliary Use-Rate Information** —Yili Hong, Virginia Tech; William Q. Meeker, Iowa State University
 - o **Reliability Analysis Based on Warranty Data with Sale and Report Lag** —Shuen-Lin Jeng, National Cheng Kung University ■

Q&P Roundtables at the 2010 Joint Statistical Meetings

Theresa Utlaut, Intel Corporation

Participating in roundtables is always a highlight at JSM. It is a great opportunity to network, share knowledge, learn from your colleagues, and enjoy good food. This year Q&P has four roundtables, one with coffee on Monday and a lunch each day.

Roundtable with Coffee

Learn about experimental design methods that are being employed by statisticians in biotechnology research and development. **Julia O'Neill** from Merck & Co. will lead a discussion titled "Designing Experiments for Biopharmaceutical Process Development."

Roundtables with Lunch

Computer experiments are becoming more prevalent and were recently featured in an issue of *Technometrics* (November 2009). **Bill Notz** from The Ohio State University will discuss "What You Always Wanted To Know About Computer Experiments But Were Afraid To Ask."

At some point in our careers, we all need to communicate statistical ideas to non-statisticians. Meet with **Di Michelson** from ISMI, who is an experienced consultant and interacts daily with scientists and engineers, as she leads a discussion on "Communicating with Non-Statisticians."

Hadley Wickham from Rice University will discuss the importance of good data visualization for both understanding your own data and explaining it to others. During the roundtable titled "Visualizing Data", he will cover the challenges you may face in your work and guide you towards literature that may help. ■

Invited Sessions for SPES Program at JSM 2010

George Ostrouchov, 2010 JSM Program Chair, Oak Ridge National Laboratory

The venue for JSM 2010 is the Vancouver Convention Center, which is a spectacular "green" structure built for a sustainable future. We have an exciting lineup of invited talks and posters that will contribute to a sustainable future of statistics in the physical and engineering sciences. As computational models become a highly complex extension of theory to simulate physical reality, statistical design and analysis of computer experiments will bring rigor and efficiency to this emerging field known as computational science. This is the theme of one SPES invited session. Another invited session considers modern design and analysis of experiments in the nano-world and other new physical and engineering settings. The third invited session is about functional data analysis approaches in physical settings. The sessions include a good mix of young speakers as well as those that are established and well known. There are also three invited posters addressing the paradigm-changing consequences of recent changes in computer chip design.

Design and Analysis of Computer Experiments

(Organizer: Boxin Tang, Simon Fraser University)

Design and analysis of computer experiments deal with efficient methods for collecting and analyzing data from computer models of scientific and technological problems. This is an area of statistics that has made a strong impact in the general scientific community. This session features four speakers: Ying Hung (Rutgers University), Chunfang Devon Lin (Queen's University), Jason Loepky (University of British Columbia – Okanagan), and William Notz (Ohio State University).

Modern Day Design and Analysis of Experiments

(Organizer: Peter Z. G. Qian, University of Wisconsin-Madison)

Modern day experiments pose new challenges, such as including a large number of factors and involving all sorts of uncertainty. The purpose of this session is to present recent methodological advances in experimental design and showcase their applications in cutting-edge problems like modeling data center thermal dynamics in the IT industry and growing nanowires and nanobelts in nano-technology. The speakers are Cheinyu Peng (Academica Sinica), John Stufken (University of Georgia), and Ching-Shui Cheng (University of California, Berkeley).

Recent Development in Functional Data Analysis

(Organizer: Surajit Ray, Boston University)

Functional approaches to modeling dynamics of physical systems, trends in financial data, and seasonal measurements of spectral bands in remote sensing data are becoming increasingly popular as a data analysis tool. The talks will include functional embedding techniques to reduce problem dimensionality, joint estimation of functions, and model-based clustering/classification. Each talk will be motivated by a unique set of applications, data observed from a well studied dynamical system, data in high dimensions, data displaying strong autoregressive framework, sparseness of observations, and non-normality. The speakers are Bani Mallick (Texas A&M University), Surajit Ray (Boston University), and Laurel Delsol (Université d'Orléans), and Steve Marron (University of North Carolina at Chapel Hill) as discussant.

Finally, computational science, where statistical design of computer experiments is beginning to have an impact, has emerged as a major consumer of high performance computing with parallel algorithms. Now, physical limits in chip design are forcing the same paradigm change in all algorithm design. Serial algorithms (including almost all of statistical algorithms) get little future speedup as new hardware is introduced. By contrast, parallel algorithms like those used in computational science can exceed clock rate increases of the past. SPES is sponsoring three invited posters on parallel computing: **Parallel Statistical Computing: Are We Embracing the Scalable Concurrency Revolution?** by George Ostrouchov (Oak Ridge National Laboratory), **Generic Framework for Parallel Statistical Computing** by Hana Sevcikova (University of Washington), and **Parallel Implementation of Response Surface Regression on R** by Hao Yu (University of Western Ontario).

Look for more details about these invited sessions as well as seven more contributed sessions sponsored by SPES in the JSM 2010 program, online at <http://www.amstat.org/meetings/jsm/2010/>. ■

SPES Short Course at JSM 2010

Tena Katsaounis, SPES Education Chair, The Ohio State University

If you are attending the Joint Statistical Meetings this year, mark your calendar for the short course, "Monte Carlo and Bayesian Computation with R" by Jim Albert and Maria Rizzo. This course was offered successfully at the Joint Statistical Meetings in Washington D.C. in 2009. SPES is excited to sponsor it again this year. Details about the course will be posted online at www.amstat.org/sections/spes and www.amstat.org/meetings/jsm/2010.

Maria Rizzo and Jim Albert are professors in the Department of Mathematics and Statistics at Bowling Green State University. Dr. Rizzo regularly teaches a doctoral-level course in statistical computing and has recently published a text on statistical computing using R. Dr. Albert has written several texts on Bayesian modeling and computation. Dr. Albert has previously taught short courses at the Joint Statistical Meetings on ordinal data modeling (with Val Johnson) and on the use of sports in teaching statistics.

This course is intended for statisticians who are interested in using R to design Monte Carlo experiments to assess the properties of statistical procedures. Also, the course is helpful for those who wish to learn about the use of R as an environment for Bayesian computations. ■

Announcing the Roundtable Luncheons at JSM 2010

Kary Myers, JSM Program Chair-Elect, Los Alamos National Laboratory

SPES is pleased to sponsor three roundtables at the 2010 JSM covering an excellent collection of topics:

Christine M. Anderson-Cook of Los Alamos National Laboratory will bring her insights to a discussion on "Balancing Competing Objectives for a Good Designed Experiment," in which she considers the practical tradeoffs involved between trusting our knowledge of a system and recognizing that we might not have correctly or completely captured the characteristics of the system.

Alexander Kolovos of SAS Institute will consider stochastic modeling of solar radiation and wind fields in a discussion of "Innovations in Spatiotemporal Analysis for Renewable Energy Research." This roundtable will provide a venue in which participants can share related methodologies and facilitate a connection between academia and industry.

Dan Nordman of Iowa State will share his experience with "Orientation Data Analysis in Physical Sciences," including development of models for directional data (like 2-dimensional wind directions) and for 3x3 rotation matrices (like crystal orientations in metal surfaces). The discussion will range from the science that generates orientation data to the statistical methodologies that have been applied to these problems.

Christine's session will be a roundtable with lunch (12:30 start time), while Alexander and Dan will be leading roundtables with coffee (7 a.m. start time).

Check out the JSM 2010 online program at <http://www.amstat.org/meetings/jsm/2010/> for more detailed descriptions of the roundtable topics. Each roundtable is limited to ten people, so please register early. Note that SPES has some scholarships available for students to attend one of these SPES-sponsored roundtables; please contact me at kary@lanl.gov to apply. ■

Volunteers Needed for SPES Presentation and Poster Awards Program at JSM 2010

Allison Rajakumar, SPES Awards Chair, The Lubrizol Corporation

As SPES members, many of you are already aware that the Section gives awards every year for the best contributed presentations and posters at the Joint Statistical Meetings. These awards are based on audience evaluations of the presentations. They recognize the best presentations in SPES-sponsored regular and special-topic contributed paper sessions.

To be successful, the awards program requires the efforts of many volunteers every year. With this in mind, I hope that some of you will kindly volunteer to help with the data collection for this year's presentation and poster awards. Being a member of the SPES Awards Committee gives you a fantastic opportunity to serve your community and to meet some of your colleagues.

Volunteer responsibilities include distributing evaluation forms to the audience in each session you agree to cover and evaluating the speakers in your sessions yourself. Volunteers are also needed to assist with the poster sessions. I would also like to encourage all members of SPES to visit the posters and provide evaluations for the poster awards program. It is your evaluations that encourage excellence in presentation among your peers and determine the selection of the outstanding poster presentation awards.

Volunteers are needed for all regular and special-topic contributed sessions primarily sponsored by SPES. The detailed session information can be found on the ASA website. If you would like to volunteer, please contact me at allison.rajakumar@Lubrizol.com or (440) 347-4679. Volunteers, as well as the award winners, will be recognized on the SPES website, www.amstat.org/sections/spes. ■

The Marquardt Memorial Industrial Speakers Program: A New Chapter in an Old Story

Mary Leitnaker, Industrial Speakers Program Chair, University of Tennessee-Knoxville

Long time members of the SPES section are almost certainly aware of the industrial speaker program that was established in 1998 in memory of Donald W. Marquardt, an ASA fellow and former ASA president. As a more recent addition to the membership of SPES, I was pleasantly surprised to find out about this very worthy program (in spite of the fact that the informational call about the program was to solicit my agreement to serve as chair of the program). But how could I refuse? What a wonderful means of inspiring another

generation of industrial statisticians. And the Marquardt Memorial Program doesn't just bring industrial speakers to college campuses to inspire and inform students about a rewarding and satisfying career opportunity. It also provides the opportunity for communication and interaction between industrial and academic statisticians.

The new chapter in this story is about the students who learn about the work of an industrial statistician. For many students this might be their first chance to learn first-hand about this career path. If you are an instructor and would like your students to have this opportunity, please go to the SPES website at www.amstat.org/sections/SPES to request a visit from an industrial statistician. Or, if you work as an industrial statistician, you can also be a part of this story. If you would like to be added to our speakers list, please send an e-mail request to Mary Leitnaker at mleitnaker@utk.edu. ■

54th Annual Fall Technical Conference

Scott D. Grimshaw, SPES FTC Representative, Brigham Young University and Dana C. Krueger, Q&P FTC Representative, Kansas State University



Birmingham, AL, site of FTC 2010.

The 2010 Fall Technical Conference will be held October 7th and 8th at the Wynfrey Hotel at Riverchase Galleria in Birmingham, AL. The theme of this year's conference will be "Quality and Statistics: The Engines of Success."

Speakers representing industry, government, and academia will present more than 30 case studies, technical talks, and panel discussions in the areas of quality and statistics. Sessions will include topics in designing experiments, reliability, multivariate quality control, and other special topics. Sessions will be suitable for the novice, as well as the seasoned quality and statistics practitioner.

Of special note this year is a session in honor of Soren Bisgaard, a fellow of both ASA and ASQ, who was well known for his contributions to industrial statistics and quality. The FTC is co-sponsored by SPES and the Section on Quality & Productivity from ASA, and the ASQ Chemical Process & Industries and Statistics Divisions, who will all have invited FTC sessions. In 2010, the ASQ Reliability Division has organized a session that would also be of interest to many attendees. As usual, *Technometrics* and *JQT* will sponsor



The Wynfrey Hotel, Birmingham, AL.

sessions that feature noted papers recently published from their respective journals.

In addition to an outstanding conference program, the following pre- and post-conference short courses are available:

Data Mining (by Julia O'Neill and Matthew Wiener)

Data mining deals specifically with problems of how to extract information from large amounts of data. Particular attention has been devoted recently to how to find meaningful relationships in data sets with many more variables than cases (the so-called $n \ll p$ case). While many of these methods were developed in the context of gene expression and other "omics" data, they are equally applicable to process data from manufacturing.

The course will consist of two sections: first, we will share recommendations for structuring team explorations of process data, gained from our experiences with multiple manufacturing investigations. Techniques are drawn from Six Sigma methodology. The second part of the course will shift to the quantitative challenges faced in understanding large volumes of data.

In this course, we will introduce powerful data mining methods including partial least squares regression (PLS) and random forests. We will explain the ideas behind the methods and demonstrate how to perform them in freely available software. We will also present examples in which applying random forests and PLS techniques to historical process data has yielded important insights into manufacturing processes. Class format is 1 day (8 hours) lecture with examples and software demonstrations using R and JMP.

Acceptance Sampling (by Dean Neubauer)

This course provides an introduction to the basic principles of acceptance sampling including concepts and terminology, how to specify a plan and derive it mathematically or graphically, and use of published plans for both attributes and variables sampling. Participants will receive a copy of the text *Acceptance Sampling in Quality Control*, 2nd ed. and a CD with MS Excel templates for sampling plans discussed in this course plus those not covered but which are in the text. Familiarity with the normal, binomial, Poisson and hypergeometric distributions is assumed. Participants are encouraged to bring their own laptop.

Logistic Regression (by Richard Lynch)

This training covers binary, nominal, and ordinal logistic regression. Students will learn to identify the context in which logistic regression applies and to fit logistic regression models using Minitab software. Students will learn to evaluate goodness of fit and interpret the models. Data formatting requirements will be explained. The role of link functions will be shown. There will be coverage of input variables that are continuous and categorical. Students will practice effective methods of reporting the findings from their modeling effort. In order to practice model fitting, each student should bring a laptop computer. A 30 day trial version of Minitab Version 15 will be made available to those students that do not already have Minitab installed. In order to load the trial version, students will need to have administrative privilege for their computers.

Survival Analysis (by Bill Meeker)

This course will present and discuss the analyses of many different life data analysis applications in the area of product reliability and materials evaluation. The analyses illustrate the use of a mix of proven traditional techniques, enhanced and brought up to date with modern computer-based methodology. Methods used in the analyses include nonparametric estimation, probability plotting, maximum likelihood estimation of parametric models, analysis of data with multiple failure modes, acceleration models, Bayesian methods, degradation analysis, and the analysis of recurrence data from repairable systems. Using a series of real examples from reliability applications, this course will focus on graphical presentation of reliability data, statistical modeling, and interpretation of results. The prerequisite is a course in applied statistics covering material through simple linear regression.

Birmingham, Alabama, is a classic southern city known for its history and hospitality. While in town for the FTC, take the opportunity to explore this beautiful city nestled in the rolling foothills of the Appalachian Mountains. For registration, visit the website <http://cba.ua.edu/ftc2010/>. ■

Q&P Program at FTC 2010

Dana C. Krueger, Q&P Program Chair, Kansas State University

FTC 2010 will be held October 7-8 in Birmingham, AL, and an excellent program has been selected. I hope you are planning to attend! The conference website with registration information, a copy of the program, and list of short courses is available at <http://cba.ua.edu/ftc2010/index.html>. Q&P is pleased to sponsor an invited session "All Aboard? Turning Passengers into Engineers: A Panel Discussion of Effective Training of Process Improvement Tools and Methods." Fredrick W. Faltin, The Faltin Group, Willis A. Jensen, W.L. Gore & Associates, and Joseph G. Van Matre, University of Alabama-Birmingham, will discuss topics such as the importance of the trainer's background, determining what makes training effective or ineffective, using the Socratic Method, and teaching health care quality. The panel will explore effective methods in both industry and in academia, and there will be time at the end of the session for audience discussion. With both theoretical and applied sessions on the program that focus on designed experiments, reliability, SPC, and special distributions, there is something for everyone! ■

Student Competition: Can You Improve a Process?

The Section on Quality & Productivity is pleased to announce a student team competition. The goal of the contest is to enhance the statistical expertise of students who are interested in a challenge and want to apply their training in statistical thinking and process improvement to a realistic situation. We believe that students who compete will develop their statistical talents and increase their marketability in the workforce.

If you are a student or know of some students who are ready to demonstrate how to improve a process by applying statistical knowledge and training, who are ready to solve a realistic industrial problem, and who may need money to attend the 2011 Joint Statistical Meetings in Miami, then the Q&P Section student team competition is the perfect plan.

With full support from the Q&P Committee, Stefan Steiner from the University of Waterloo is coordinating this competition. There is a simulated manufacturing process called “Watfactory” that allows users to plan and execute empirical investigations of many different types. The process map (Figure 1) captures some of the available knowledge including the 60 varying inputs (x_1, \dots, x_{60}) that drive the output variation and the 30 normally fixed inputs (z_1, \dots, z_{30}) that can be changed to improve the process. You can also implement various control schemes and inspection points. There are costs associated with each study and each change to the process. Each team will start with an initial virtual budget of \$10,000. Currently, there is too

much variation in the critical final output y_{300} . The object is to reduce the output variation with minimal expense.

If you think you are up to the task, we are looking for teams (2-5 students with a faculty mentor) who are learning or are knowledgeable about Six Sigma or other process improvement algorithms, who enjoy a challenge and competition and want to apply statistical thinking and methods to a realistic problem.

More background information about the process and a guest login (helpful for exploring how Watfactory works but not the same version of the process as used in the competition) are provided at www.student.math.uwaterloo.ca/~stat435/login.htm

The winning team will present their results and methods at a special topic contributed session at the Joint Statistical Meeting (JSM) July 30-August 4, 2011, Miami Beach Convention Center. There is a \$500 cash prize for the winning entry plus up to \$1000 per student (max 3 students) for travel expenses to attend JSM.

If you are interested, then the faculty mentor should email Stefan Steiner sbsteiner@uwaterloo.ca to register teams, to acquire access to the contest version of the process, and to get more information about the contest rules and timelines.

To be considered for the prize, each team must register no later than December 31, 2010 and submit a final report by March 15, 2011. The report must describe the proposed solution to the problem, how well it works, how much it costs and, most importantly, the steps taken and the logic behind these steps in reaching the solution. Detailed guidelines about the process, the contest and the judging will be provided upon registration. ■

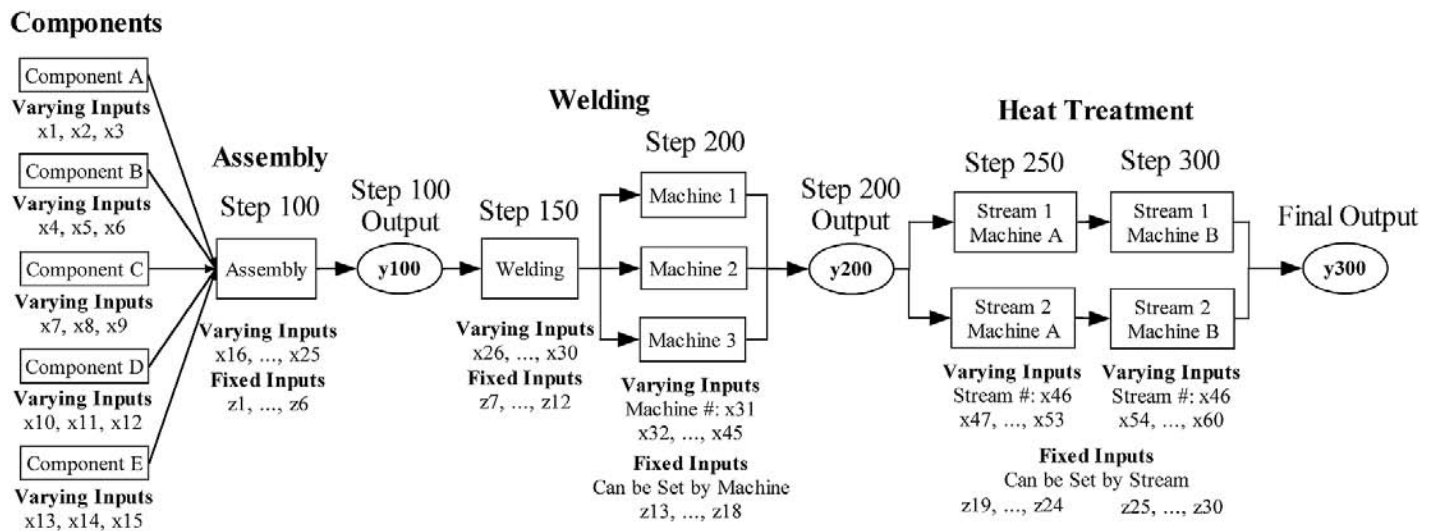


Figure 1. Watfactory Process Map

Understanding Logistics in System Analysis

Jorge L. Romeu, Ph.D., Research Professor, Dept. Mech & Aerosp. Eng., Syracuse University

Introduction

The possibility of providing maintenance to a system, thereby extending its life and usefulness, introduces two important concepts into systems analysis: availability and logistics. Availability is the probability that “an item is in an operable and committable state at the start of a mission, when the mission is called for at an unknown (random) time” (1), and has been discussed at length in another paper (2). Related to availability, maintainability is “a measure of the ability of an item to be retained in, or restored to, a specified condition when the maintenance is performed during the course of a specified mission profile” (1). Maintainability, in turn, brings in the topic of this article: logistics. As defined in (3), integrated logistics support (ILS) is a “disciplined, unified, and iterative approach to the management and technical activities necessary to (i) integrate support considerations into system and equipment design; (ii) develop support requirements related consistently to readiness objectives, to design, and to each other; (iii) acquire the required support; and (iv) provide the required support during the operational phase at minimum cost.”

As seen in the above definition, logistics includes not only the maintenance itself (e.g., repairs) but also the organization behind all such maintenance operations as well as parts and equipment necessary to perform repairs during the system’s operational phase. It is further desirable to achieve logistics support at a minimum cost. Therefore, we need to consider, in addition to the administrative and organizational issues related to its management, the statistical models required to analyze the random processes behind system breakdowns and repairs.

This article provides an example of the advantages of including maintenance as part of a system’s logistic strategy, and then overviews several statistics techniques that can help plan and optimize the inventory required in the logistics activity.

Advantages of System Maintenance

Systems can be of two types: “one shot,” if they operate until they fail, or “maintained,” if they can be repaired and put back into service when they go down. Comparing the two approaches for equivalent systems can assess the advantages of each. For example, a one shot system is presented in Figure 1-a. It is composed of two identical units in parallel such that the system can be in three states: up (both units operating), down (neither unit operating) and degraded (one of two units operating). On the other hand, if the system is maintained, provision is made for repairing the system when it goes down.



Figure 1. Parallel system of two identical units: (a) block diagram; (b) state diagram.

A maintained version of our above example would have the same configuration, but now failed units may be repaired and returned to operation. This considerably extends system life. The system also works in a degraded state while being repaired, as long as there is one unit still functioning (Figure 1-b).

As an illustration, let each of the two identical components have a mean time to failure (MTTF) of $MTTF = \mu = 1/\lambda = 500$ hours ($\lambda = 0.002$ is the rate parameter for an exponential probability density function describing time to failure). Then, the long-run total system MTTF is (4):

$$MTTF = \mu = \frac{1}{\lambda_1} + \frac{1}{\lambda_2} - \frac{1}{\lambda_1 + \lambda_2} = \frac{2}{\lambda} - \frac{1}{2\lambda} = \frac{3}{2} \times 500 = 750 \text{ hours.}$$

Hence, the non-maintained version would have 750 hours of expected life before going down.

For comparison, suppose the system is maintained, with mean time to repair (MTTR) $\eta = 30$ hours ($\rho = 1/\eta = 0.033$), when operating in a degraded state, as in Figure 1b. Since maintenance is now possible, the system achieves an increase of its expected life (mean time to go down) of $\rho/2\lambda^2 = 0.033/(2 \times 0.002^2) = 4125$ hours. Such an increase occurs because the new expected life of the system is now the sum of the original non-maintained expected time to failure, plus the additional expected time produced by having system maintenance ($\rho/2\lambda^2$). Consequently, the new overall expected time for the system to go down (mean time between failures [MTBF], since the system can now be repaired), starting from the state of being up, becomes:

$$MTBF = 3/2\lambda + \rho/2\lambda^2 = 750 + 4125 = 4875.$$

System maintenance also allows the system to achieve, during its life, an availability (A) of:

$$A = P\{\text{system is up}\} = \frac{\text{up time}}{\text{cycle time}} = \frac{MTBF}{MTBF + MTTR} = \frac{4875}{4875 + 30} = 0.9938.$$

This example illustrates some of the practical advantages of maintainable systems. It also underlines how a reduction in system maintenance times MTTR produces an increase in system availability, among other benefits to the entire long-term systems operation. Maintenance time reduction may be obtained by having an efficient logistics program in place. In the rest of this paper, the concept of logistics and several ways to improve logistics-related activities, from a managerial as well as from a statistical standpoint, are discussed.

Some Statistical Procedures used in Logistics

Improvements in the system maintenance process can extend system life and availability. But maintenance time includes, in addition to repairs proper, the logistics delay time (i.e., waiting for parts if they are not in stock). Logistics planning requires the calculation of the adequate number of parts that we must keep in inventory (sparing) so as to reduce the risk of system unavailability and down time. In this section I overview some of the statistical issues in logistics planning.

1. Sparing models: determining the number of spare parts.

All sparing derivations below correspond to exponential lifetimes only. This implies that the failure rate is time independent (constant),

and that the number of failures observed in time interval $[0, t)$ are Poisson-distributed.

Suppose a system requires one operating part to fulfill its mission in time interval $[0, t)$. How many spares, k , of such part, are needed in the inventory to avoid logistics delay? We first need to define the reliability requirements, $R(t)$, of the system in order for us to keep enough spares, k , to immediately replace the number of failed parts during mission time, t . Due to the exponential lifetime assumption, the number of failures during mission time t is a Poisson random variable:

$$R(t) = P\{\text{system successfully completes mission}\} = P\{\# \text{ of failures in } [0, t) \text{ is } \leq k\} = P\{N(t) \leq k\} \\ = \sum_{n=0}^k P\{N(t) = n\} = P\{N(t) = 0\} + \dots + P\{N(t) = k\} = e^{-\lambda t} + \dots + e^{-\lambda t} (\lambda t)^k / k! .$$

To find the number of spares required for immediate repair, the equation is solved for k , and desired reliability, $R(t)$.

Example: Let failure rate $\lambda = 0.01/\text{hr}$ and mission time $t = 1000$ hours. Find the number of spares k such that system reliability is $R(t) > 0.95$. Using Poisson tables for $\lambda t = 10$ we obtain:

$$R(t) = \sum_{j=0}^k P\{N(t) = j\} = e^{-\lambda t} + \dots + \frac{(\lambda t)^k e^{-\lambda t}}{k!} > 0.95 \Rightarrow k = 15 \text{ yields } R(t) = 0.9512.$$

Therefore, we would need to keep a minimum of $k = 15$ spares, to avoid running out of spares during mission time and thus, ensuring that system reliability is at least 0.95.

2. Additional sparing examples.

Suppose now that system reliability is pre-specified. We want to determine the number of spares k , to have in the inventory, in order to ensure that enough are available at least X percent of the time, regardless of the length of mission time. In this case, we can use a revised version of the reliability model. Note that $R(t) = e^{-\lambda t}$ and that $\ln\{R(t)\} = \ln\{e^{-\lambda t}\} = -\lambda t$. Therefore, denoting P as the desired probability of having a spare part available, when needed (i.e., while we still have some of the k spares), we can rewrite the Poisson equation:

$$P = P\{N(t) \leq k\} = \sum_{n=0}^k \frac{(\lambda t)^n e^{-\lambda t}}{n!} = e^{-\lambda t} + \dots + \frac{(\lambda t)^k e^{-\lambda t}}{k!} = \sum_{n=0}^k R(t) (-\ln\{R(t)\})^n / n!$$

Example: Suppose that system reliability is $R(t) = 0.8$. What inventory size, S , of available parts are needed to ensure that a spare is at hand, at least 99% of the time?

$$P = 0.99 \leq \sum_{n=0}^S R(t) (-\ln\{R(t)\})^n / n! = \sum_{n=0}^S 0.8 (-\ln\{0.8\})^n / n! = 0.8 + 0.178 + 0.020 + \dots$$

Hence, it is enough to keep an inventory of $S = 2$ parts, since the above sum, for $n = 0$ to $n = 2$, fulfills the desired $P = 0.998 > 0.99$.

This model can also be used for more complex sparing situations. For example, suppose that a system requires 12 identical parts to operate, and that each part has a failure rate of $\lambda = 0.01$ failures/1000 hours. If the system must operate continuously for a year ($7 \times 24 \times 52 = 8736$ hours), what inventory size, S , do we need to keep, to ensure that at least one part will be available, at least $P = 95\%$ of the time?

To compute the system reliability for the required mission time, we need to take into account that all system parts must be working. Hence, we convert the failure rate to hours, and multiply it by the mission time ($t = 8736$ hours), and by the number of parts that the system requires to operate ($k = 12$ items). That is:

$$k \times \lambda \times t = 12 \times (0.01/1000 \text{ hours}) \times (8736 \text{ hours}) = 1.04832.$$

Reliability is then computed as: $R(t) = e^{-k\lambda t} = e^{-1.04832} = 0.35053$.

$$P = 0.95 \leq \sum_{n=0}^S R(t) \times (-\ln\{R(t)\})^n / n! = \sum_{n=0}^S 0.35 \times (-\ln\{0.35\})^n / n! = \\ 0.35 + 0.37 + 0.19 + 0.07$$

The above sum yields 0.98, for $S = 3$. Hence, it is enough to keep three spare parts in inventory, to ensure that a spare part will be available at least 95% of the time. There are also nomographs available, that provide these results directly without having to calculate the above Poisson probabilities (for examples, see Ch. 2 of Reference 3).

3. Determining risk-dependent maintenance times.

Having the proper number of spares in inventory is only one factor in achieving an efficient logistics process. It is also important to be able to accurately predict maintenance times. Fitting a statistical distribution and computing the probability of observing particular maintenance times most easily accomplishes this. Maintenance times can usually be fitted one of several statistical distributions, e.g. normal, lognormal, or exponential (5, 6). A goodness-of-fit (GoF) test can be used on observed data, to determine which distribution fits most appropriately. Then, given a selected risk (probability that maintenance will be completed by a pre-specified time), we can obtain the corresponding time percentile (e.g., max, min, median etc.) from the fitted distribution and use it to plan our logistics needs.

Example: Suppose that we implemented a GoF test on maintenance time data and found that the time to repair (X) has a log normal distribution (7, 8). If X is lognormal, then $\ln(X)$ is normal. Hence, we can log-transform the repair time data and use the standard normal distribution to compute probabilities. Further suppose that the log-transformed maintenance time data yielded a mean of 3.5 and a standard deviation of 1.2, and that we require the 90th percentile of maintenance times (i.e., 90% of all maintenance operations would be completed by such time). This percentile defines the risk we are willing to run in our planning processes (as 10% of the times, maintenance will exceed the planned time).

The standardized 90th percentile ($z = 1.28$) is obtained from the standard normal table. The back-transformed percentile (Perc.90) of the log-transformed (normal) repair time data is then:

$$90^{\text{th}} \text{ } z\text{-percentile} = 1.28 \Rightarrow \frac{\text{Perc.90} - 3.5}{1.2} = 1.28 \Rightarrow$$

$$\text{Perc.90} = 3.5 + 1.28 \times 1.2 = 5.036$$

Perc.90 = 5.036 corresponds to the log-transformed data; hence, the estimated 90th percentile of the actual maintenance times is $e^{5.036} = 153.8$ hours. Therefore, 10% of repair times will take more than 153.8 hours to complete. We can use this time (153.8 hours) for logistics planning, with a risk of 10% of overshooting. If the risk required is different (e.g. 5%), solve for another percentile (95th z -percentile = 1.65). If the maintenance time distribution is other than normal or log normal, look up the percentiles in the table of the identified statistical distribution.

4. Other models used in logistics.

There are many operations research (OR) models that can be used to optimize logistics processes. For example, inventory models help determine the organization of sparing policies (e.g. inventory size, reordering times, quantities, etc.). Transportation models help determine the most efficient locations of warehouses. Assignment

models help identify the best trucking routes to restock them and which warehouse or job shop should serve which customer. OR models often use linear and integer programming to find an optimal (maximum or minimum) solution of an objective function (performance measure) when it is subjected to a set of constraints (limitations). Goal programming is used to determine the optimal policy in the presence of several competing and conflicting objectives, all of which we want to meet simultaneously.

Details of operations research models are beyond the scope of this article. The interested reader can find extensive discussions of these models, as well as many illustrative examples in (9).

Bibliography

1. MIL-STD-721C: Military Standard, Definitions of Terms For Reliability and Maintainability. U.S. Department of Defense. Washington, D. C., 1981.
2. Understanding Availability Statistics. Romeu, J. L. Reliability Analysis Center (RAC) Selected Topics in Assurance Related Technologies (START), Vol. 11, No. 6.
3. Logistics Engineering and Management. Blanchard, B. S. Prentice Hall. NJ, 1998.
4. Understanding Series and Parallel Systems. Romeu, J. L. RAC START, Vol. 11, No. 5.
5. Empirical Assessment of Normal and Lognormal Distributions. Romeu, J. L. RAC START, Vol. 9, No. 6.
6. Statistical Assumptions of an Exponential Distribution. Romeu, J. L. RAC START, Vol. 8, No. 2.
7. The Chi-Square: a Large Sample GoF Test. Romeu, J. L. RAC START, Vol. 10, No. 4.
8. The Anderson-Darling: a Small Sample GoF Test. Romeu, J. L. RAC START, Vol. 10, No. 5.
9. Introduction to Operations Research. Hillier and Lieberman. Prentice Hall. 1990. ■

2010 SPES Officers Directory

Position	Officer	Email	Phone
Chair	Russ Lenth	russell-lenth@uiowa.edu	(319) 335-0814
Chair-Elect	Phil Scinto	prs@lubrizol.com	(440) 347-2161
Chair-Elect-Elect			
Past-Chair	Tom Loughin	tloughin@sfu.ca	(778) 782-8037
Secretary-Treasurer	Stephanie Pickle	stephanie.pickle@usa.dupont.com	(302) 774-0147
JSM Program Chair	George Ostrouchev	ostrouchovg@ornl.gov	(865) 574-3137
JSM Program Chair-Elect	Kary Myers	kary@lanl.gov	(505) 606-1544
JSM Program Chair-Elect-Elect			
COS Representative	Greg Piepel	greg.piepel@pnl.gov	(509) 375-6911
COS Liaison			
COS Governing Board vice chair for SPES	Tim Hesterberg	TimHesterberg@gmail.com	(206) 876-1790
Awards Chair	Allison Rajakumar	allison.rajakumar@lubrizol.com	(440) 347-4679
Chemometrics Comm. Chair	Raymond Lam	ray_lam@merck.com	(732) 594-3939
Statistics in Chemistry Award Chair	Ken Goldberg	kgoldber@its.jnj.com	(610) 651-6924
Chemometrics Program Chair	Kerby Shedden	kshedden@umich.edu	(734) 764-0438
Education Chair	Tena Katsaounis	katsaounis.1@osu.edu	(419) 755-4032
FTC Program Committee Representative	Scott Grimshaw	grimshaw@byu.edu	(801) 489-4101
FTC Steering Committee	Jeff Luner	jeffery.j.luner@boeing.com	(314) 232-6013
Industrial Speakers Program	Mary Leitnaker	mleitnaker@utk.edu	(865) 974-1639
Membership Chair	Jennifer Golek	jgolek@barclaycardus.com	(302) 255-7416
Operating Manual Chair	Walter Morgan	morganw@rjrt.com	(336) 741-5419
Publications Chair	Jim Rutherford	JARU@chevron.com	(510) 242-3410
Senior Newsletter Editor	Shilpa Gupta (Q&P)	shilpa.gupta@asu.edu	(602) 432-0949
Associate Newsletter Editor	Michelle Zeisset	mzeisset@hotmail.com	(575) 679-1012
Publicity Chair	Melissa Ziegler	Melissa.Ziegler@usa.dupont.com	(302) 695-2582
SRC Mgt. Comm. Chair	Shane Reese	reese@stat.byu.edu	(801) 422-9250
SRC Mgt. Comm. Rep.	Roshan Vengazhiyil	roshan@isye.gatech.edu	(404) 894-0056

2010 SPES Officers Directory

SRC Mgt. Comm. Rep.	Peter Hovey	peter.hovey@notes.udayton.edu	(937) 229-2964
SRC Mgt. Comm. Rep.	Ted Allen	allen.515@osu.edu	(614) 292-1793
SRC Program Co-Chair			
SRC Program Co-Chair			
SRC Program Co-Chair			
Web Master	Randy Tobias	randy.tobias@sas.com	(919) 531-7933

2010 Q&P Officers Directory

Position	Officer	Email	Phone
Chair	Mark Bailey	mark.bailey@sas.com	(856) 616-0644
Chair-Elect	JD Williams	williamj@research.ge.com	(518) 387-7322
Past Chair	Martha Gardner	martha.gardner@research.ge.com	(518) 387-6546
Secretary	Diane K. Michelson	di.michelson@ismi.semtech.org	(512) 356-3238
Treasurer	Sharad Prabhu	sassxp@sas.com	(919) 677-8000
JSM Program Chair	Dana C. Krueger	dkrueger@ksu.edu	(303) 401-1743
JSM Program Chair Elect	Theresa Utlaut	theresa.l.utlaut@intel.com	(503) 613-7763
Publications Chair	Will Guthrie	will.guthrie@nist.gov	(301) 975-2854
Publications Chair Designate	Ben Ahlstrom	Ben.ahlstrom@amgen.com	
Webmaster	Jason Gillikin	jason.gillikin@spectrum-health.org	
Senior Newsletter Editor	Shilpa Gupta	shilpa.gupta@asu.edu	(602) 432-0949
Associate Newsletter Editor	Phil Ramsey	pjramsey@cisunix.unh.edu	
Council of Sections Representative	Sarah Kalacin	sarah.kalacin@intel.com	(201) 847-5740
Continuing Education Committee Chair	Reid Landes	rdlandes@uams.edu	(501) 526-6714
Committee to Nominate Fellows Chair	Willis Jensen	wjensen@wlgore.com	
Committee to Nominate Fellows	Lynne Hare	lynne.hare@comcast.net	(908) 879-0610
Committee to Nominate Fellows	TBD		
QPRC Steering Committee Chair	Jeff Hooper	jhooper@ins.com	(908) 559-3026
Malcolm Baldrige Award Liason	TBD		
Mary Natrella Scholarship Committee Chair	Keith Eberhardt	keith.eberhardt@kraft.com	(973) 503-3481
Mary Natrella Scholarship Committee	Will Guthrie	will.guthrie@nist.gov	(301) 975-2854
Mary Natrella Scholarship Committee	Scott Kowalski	skowalski@minitab.com	(407) 718-9501
Mary Natrella Scholarship Committee	Christina Mastrangelo	mastr@u.washington.edu	(206) 543-5439
Mary Natrella Scholarship Committee	Sharad Prabhu	sassxp@sas.com	(919) 677-8000
FTC Steering Committee Member	Fred Faltin	fred.faltin@falingroup.com	(518) 885-7071

The logo for Q&P SPES News. It features a large blue 'Q' on the left, a smaller blue '&' in the middle, and a large blue 'P' on the right. Below these letters, the word 'SPES' is written in a bold, blue, sans-serif font. At the bottom, the word 'News' is written in a white, serif font on a blue rectangular background.

Shilpa Gupta
SPES/Q&P Senior Editor
Department of Industrial Engineering
Arizona State University
Mail Code 87-5906
Tempe, AZ 85287-5906
(602) 432-0949
shilpa.gupta@asu.edu



Michelle Zeisset
SPES Associate Editor
746th Test Squadron, USAF
1644 Vandergrift Road
Holloman AFB, NM 88330
(575) 679-1012
michelle.zeisset@holloman.af.mil



Phil Ramsey
Q&P Associate Editor
Dept. of Mathematics & Statistics
University of New Hampshire
Durham, NH 03824
(603) 862-2320
pjrstats@aol.com