The Department of Mathematics at the University of Colorado-Denver &
The Colorado Wyoming Chapter of the American Statistical Association
Present

Exploratory Data Analysis In the Twenty-first Century: Research in Modern EDA

A Symposium Honoring John Wilder Tukey (1915-2000)

Saturday,
October 27, 2001
9 AM – 5 PM

University of Colorado, Denver
1250 Fourteenth St., Room 470
Denver, Colorado

J. W. Tukey

Introduction:
Richard L. Scheaffer,
President, American Statistical Association

Keynote Address:
"The Age of Tukey" – James R. Thompson,
Rice University.

Other Speakers:
Luisa Fernholz, Temple University: **"Tukey's Last Work: The Multihalver Jackknife"**
Robert Launer, Senior Program Director, ARO **"Tukey's Service to the Government"**
Lyle Jones, University of North Carolina **"Multiplicity Personified"**
James Filliben, National Institute for Standards and Technology
Howard Wainer, Educational Testing Service
Karen Kafadar, University of Colorado, Denver

Registration: **$20 prior to October 26, 2001 or $30 at door.**
(Students: $10 advance or $15 at door)

Forward name & affiliation with check payable to ASA, Colorado-Wyoming Chapter to:
(Students, please include photocopy of current student ID to confirm eligibility.)

Karen Kafadar, Dept. of Mathematics
University of Colorado – Denver
P.O. Box 173364, Denver, CO 80217-3364

Current program available at **http://www.stat.colostate.edu/ASA/Meetings/**

John Wilder Tukey, who died in July 2000, made contributions as a mathematical statistician that are long heralded as widely influencing science and modern society. "I believe that the whole country — scientifically, industrially, financially— is better off because of him, and bears evidence of his influences, " said John A. Wheeler. A major figure in the history of physics and the atomic bomb himself, Wheeler said elsewhere, "If you had money in the bank you always have a sense of assurance.....and John Tukey was a special kind of money in the bank, because you could take up a difficult question with him and get a new point of view and sound advice. The country will be poorer for his loss."

Dr. Tukey pioneered the plotting, and graphical methods of Exploratory Data Analysis that have become "fixtures" in introductory Statistics texts. Methods such as Box and Whisker, Stem and Leaf Diagrams, Tukey's Paired Comparisons, are familiar if not whimsical reminders of his contributions. However he was recently credited as having introduced, the computing terms "bit" (binary digits) and "software." He was reportedly unaware that he was thus recognized until quite late, and actually did not personally use computers, but was on very good terms with the operators instead.

He was instrumental in methods of robust analysis and time series analysis. In 1965, he and J.W. Cooley introduced an algorithm called "fast Fourier transforms." These familiar and "ubiquitous" techniques are for investigating waveforms found in physical sciences, and are widely applied, for example, in chemical spectrographic analysis or tests done in the electrical engineering sciences.

John Tukey helped initiate the Princeton Department of Statistics in 1966, and served as its chairman from 1966-69. "He probably made more original contributions to statistics than anyone else since World War II, " said now retired Harvard mathematical statistician Frederick Mosteller. "He did an amazing number of things....and was a good and energetic teacher," said mathematician and former Princeton dean Robert Gunning.

Dr. Tukey was part of the President's Science Advisory Committee, chaired major environmental committees, and helped to monitor the nation's school system. He was a member of Technical Working Group 2 of the Conference on the Discontinuance of Nuclear Weapons Tests, and a delegate to the United Nations Conference on the Human Environment in Stockholm, Sweden. John Tukey received the National Academy of Sciences Award in 1961, the National Medal of Science from President Richard M. Nixon in 1973, and the IEEE Medal of Honor in 1982.

John W. Tukey was born July 16, 1915 in New Bedford, Mass. He was "home schooled" by his parents who were also teachers. He studied chemistry and mathematics at Brown University as an undergraduate, and received a Masters degree there in chemistry. He then continued in mathematics at Princeton and received his doctorate in mathematics in 1939 after completing a dissertation in Topological Denumberability. This was republished in 1940 as "Convergence and Uniformity in Topology." David Hoaglin, who co-authored many books and papers with Dr. Tukey, said that Tukey "had a penetrating understanding of so many areas of the field of statistics and was happy to share those insights with anyone who engaged him in discussion . . . it is hard to find an area that he did not work in or have a significant impact on."

Local Announcements:

Notes from Karen Kafadar: CU-Denver Math Dept. is conducting a search for a chairman. For details, link to <www-math.cudenver.edu> .

Also CU-Denver meets monthly or bi-monthly for a "Statistics Discussion Group." Participants from any field are welcome to come and present their problem that may require statistical expertise. Exact solutions are not guaranteed! But the discussions are always interesting, informative, and useful, both to the person presenting the problem and to those in attendance. The Group meets on the last and/or first Friday of the month; for more details, link to <www-math.cudenver.edu> or send mail to <kk@math.cudenver.edu> or <mjpocern@ouray.cudenver.edu>. Thanks—K.K.

Notes from Jim zumBrunner: CSU's Peter Brockwell is on sabbatical this year, visiting the Mathematics Center, Technical University of Munich, from September 17th through March 30th as the John von-Neumann Distinguished Visiting Professor.

For the 2001-02 academic year, Kamil Feridun Turkman and Maria Antonia Turkman, Professors of Statistics in the Department of Statistics and Operations Research at the University of Lisbon, Portugal will be visiting the CSU Department of Statistics.

The Department of Statistics at Colorado State University invites applications for 1 or 2 tenure-track faculty positions starting Fall 2002. Further information about the department and positions is available on the web page <www.stat.colostate.edu> Women and minorities are encouraged to apply. Colorado State University is an EEO/AA employer. Thanks -- Jim_z

Notes from Dana Franklin: FYI CU-Denver's Statistics Consulting Service. The CU-Denver Math Department operates this service, in which statistics faculty are available as consultants by appointment. Projects in any field are accepted. Personnel are: Dana Franklin, Coordinator, Mark Fitzgerald, Craig Johns, Karen Kafadar. Areas of statistical expertise include: Exploratory data analysis ("data mining"); Spatial statistics; Interlaboratory studies; Industrial statistics (e.g., product/process control); Engineering statistics (e.g., experimental design); Robust and nonparametric methods; and Climate modeling.

Past projects: CU Department of Psychology: Women in the workplace (factor analysis); CU Graduate School of Public Administration: Survey design (design and analysis of customer surveys); Customer Satisfaction Systems: Hospital survey (analysis of data from customer satisfaction surveys); U.S. Geological Survey: Quality Inspection (Short courses in statistical quality control and exploratory data analysis); University of Colorado Health Sciences Center: Community intervention studies (design and analysis of large community trials) ; Diagnostic Imaging: Diagnostic medical tests (sensitivity/specificity analyses); National Cancer Institute: Screening tests for cancer (design and analysis of randomized screening trials); OE, Inc.: automotive products manufacturing (design of experiments for process/product improvement); Los Alamos National Laboratory: Interlaboratory Studies.

You may contact the Statistics Consulting Service for statistical advice at any stage of your research. However, most clients find it most beneficial to contact us in the early stages of the study so that issues of sample size, experimental design, and efficient utilization of resources can be

addressed, before the study is actually run.

There are accommodating consultation fees. CU-Denver Graduate students: free (thesis or dissertation only) All others pay a nominal fee, depending upon affiliation (CU-Denver faculty / Government, Non-profit / Corporate) Your local point of contact is Dana Stientjes Franklin Technometrics Editorial Coordinator, for Karen Kafadar, voice (303) 556-6269, fax (303) 556-8550 or by email <dfrankli@math.cudenver.edu>.

Wider notes of interest:

The new House Science Committee Chairman is Sherwood Boehler. He's profiled, here by his remarks and concerns. These spending issues may give members ideas of funding niche or joint ventures. Members might note that, in Boehler's view, local points of contact, such as supporting business or a congressional district, are overlooked opportunities in that those are the final votes, up or down, of the budget processes. The committee has such a big name, but is only a piece of the process, and local leaders might need to be kept better apprised as they are an important piece of the political context. He is a New York republican, who said the committee expects more support for sciences.

"The Administration's budget this year reflects the President's campaign priorities, which, not surprisingly, did not include R&D outside of the NIH. The budget does not reflect any hostility toward, or ideological grudge against R&D spending, and indeed the budget language already signals an intention to increase spending for NSF in the next budget." Republicans will stick with the overall domestic discretionary number."

He continued later: "In 2002, we'll see some small improvement over the proposed budgets. The final Budget Resolution we will vote on later today provides for a 5 percent increase in overall domestic discretionary spending, one percentage point higher than what the President proposed. That means that more money will be available for science spending, and I will be working with the Appropriations Committee to ensure that as much of that money as possible is allotted to research. One thing that will be different this year with all the budget machinery controlled by the Republican Party is that we will stick to that overall domestic discretionary number. In the past few years, the budget numbers vanished each fall like the Cheshire Cat, leaving only a mocking grin. Those days are over..... (The new congressional Senate Budget Chair was dismissed as a "numbers guy," around the Capitol, and chastised as unnecessary input to budgetary processes. The new guy can mentally recalculate baseball statistics during games as the players run through the line up. JET) .....and people are going to have to pay more attention to the bottom line numbers in the Budget Resolution than they have in the past. And that brings me to my final point, which is a cautionary one."

"Even though science can draw on a remarkably large reservoir of good will, even though science spending will grow more in 2002 and 2003 than the current numbers on the table might indicate, the scientific community still has its work cut out for it. That's because the overall projected growth in domestic discretionary spending for 2003 and beyond is only enough to cover inflation. The actual figure is likely to be higher than that, but spending growth will be constrained. That means the competition for federal dollars will be fierce. So what supporters of research need to begin doing now is reinforcing the arguments for the federal investment in R&D. That means

reinforcing them analytically and politically."

"Reinforcing the case for R&D analytically means providing good, solid arguments for specific levels of spending and not just throwing the word "doubling" around as if it cast a magic spell. And it means providing good, solid thinking about what it may mean to have a balanced federal research portfolio."

"Reinforcing the argument for R&D politically means making sure you are working with all Members of Congress back home in their districts and that business leaders are making clear their reliance on federal R&D. Leaders of the scientific community spend far too much time with their natural allies, like me; and far too little time convincing newer or more skeptical Members of Congress that R&D makes a difference in their districts and to the nation. The scientific community must not be complacent, and it cannot assume that it inherently has the greatest claim to, or most self-evident argument for federal largess. That's a recipe for failure."

"Finally, the scientific community must demonstrate that it is bringing its enormous resources to bear on central national problems. I'm thinking especially of education. The university community often talks about the link between research and education, but that must be more than just a rhetorical flourish. Universities must not only focus more on undergraduate education even as they continue to offer world-class graduate programs; universities and businesses must play a greater role in improving K-12 education. And in the next week or so I will unveil a bill that will help and encourage them to play such a role. If research is going to continue to merit large-scale public support and as it must and then the research establishment must rededicate itself to addressing our most pressing and perplexing public needs."

ASA Co-Wyo Members might be interested in how the Bill's rhetorical language reflects concerns raised during the budget hearings. These documents can give members an insight into how the projects are going to be chosen or evaluated. Following the Bill, are quotes of concerns and issues raised during the Science Committee's budget hearings. These are worth considering when making political assessments, as he suggested when seeking to access the system.

H.R. 1858—The National Mathematics and Science Partnerships Act

President Bush proposed in his budget to draw on the expertise of the National Science Foundation to encourage the establishment of mathematics and science education partnerships. The Partnerships Act authorizes the National Science Foundation (NSF) to stimulate the development of innovative elementary and secondary mathematics, science, engineering and technology education partnerships across the country.

Title I Mathematics and Science Education Partnerships

Title I of the Partnerships Act authorizes the establishment by NSF of mathematics and science education partnerships to be run by universities in partnership with local education agencies. These partnerships will focus on a wide array of reform efforts ranging from professional development to curriculum reform. The partnerships may include the state education agency and 50% of the awards must go to partnerships that include business partners. The pro-

gram is authorized at $200 million per year for each of the next five years as requested by President Bush.

The bill also establishes a small partnership program through which universities will provide scholarships to math and science teachers to allow them to participate in research projects at university, business, state or federal laboratories. This program is authorized at $15 million for each of the next five years.

Title II National Science, Mathematics, Engineering, and Technology Education Digital Library.

The National Science Foundation has begun the process of establishing a digital library for the reform of undergraduate mathematics, science, engineering and technology education. The Partnerships Act authorizes the expansion of the National Science, Mathematics, Engineering, and Technology Education Digital Library to include peer reviewed elementary and secondary mathematics, science, engineering, and technology education materials. The purpose of the Digital Library is to provide teachers with a web site through which they can easily locate peer reviewed education materials and information for use in their classrooms. The program is authorized at $20 million per year for each of the next five years.

Title III-Strategic Education Research Program

Title III of the Partnerships Act responds to several recent studies by the National Academy of Sciences. The Act authorizes the establishment of four national centers at universities for research on learning and education improvement. The multi disciplinary research centers will not only conduct research in cognitive science and related fields, but also will reduce the results of that research to educational practice. The program is authorized at $12 million per year for each of the next five years.

Title IV Robert Noyce Scholarship Program

Title IV of the Partnerships Act establishes a new scholarship program designed to encourage mathematics, science, and engineering majors to pursue careers in teaching. The program provides grants to universities to enable them to offer scholarships to mathematics, science and engineering majors. The students will be eligible for up to $7500 in each of their junior and senior years and must teach two years for each year of scholarship they receive. The institution will also be provided funds to operate education and support programs for the scholarship recipients before and during their years of teaching service. A smaller stipend may also be offered to math, science, or engineering professionals who need course work to enter teaching. The program is authorized at $20 million per year for each of the next four years. (Robert Noyce was an inventor of the transistor and founder of Intel Corporation.)

Title V Science, Mathematics, Engineering, and Technology Business Education Conference

The business community is becoming more and more engaged in efforts to improve elementary and secondary mathematics and science instruction. Businesses seeking to establish partnerships in their own communities can learn valuable lessons from the

experiences of existing successful partnerships. The Partnerships Act authorizes the Director of the Office of Science and Technology Policy to convene a conference to explore ways that members of the business community can expand their efforts to improve elementary and secondary mathematics, science, engineering and technology education.

Title VI Requirements for Research Centers

Title VI of the Partnerships Act recognizes that the need to improve elementary and secondary mathematics, science, engineering, and technology education requires full participation by all segments of the research and education community. The Partnerships Act requires the Director of NSF to ensure that any NSF grants that establish new research centers at institutions of higher education incorporate an elementary and secondary mathematics, science, engineering or technology education component as part of their program.

As the Science Committee chair suggested, there are "issues and questions" that are considered at each phase of the process and which stakeholders must account for when accessing the system. These following quotes were topic introductions, discussed during the budget hearings and are a glimpse of how projects may be evaluated. Not only must there be an analytical framework, as he suggested, there must be a political framework as well. Take advantage of knowing those boundaries when considering cooperative ventures.

"What are the current goals of NSF with regard to math and science education? How Are these goals assessed? How frequently? ....How have NSF's systemic reform programs been progressing? Can NSF show actual improvement in student learning and test scores? What level of coordination exists between NSF and other federal agencies that support math and science education programs? Is there an effort to communicate with private sector producers of math and science programs? How effective has the EPSCoR program been in improving the competitive position of schools in the program? Is there coordination between different sub-activities in the EHR Directorate for particular issues, such as education research, teacher training and development, and curricula design? How are initiatives highlighted in the request able to meet the current and future needs of researchers? How does NSF funding contribute to a balanced research portfolio? Is NSF emphasizing the right research areas? What other areas of research should receive priority? Do researchers have concerns with the current peer-review process employed by NSF? How could the process be improved? What is NSF doing to improve the length and size of grant awards? How should NSF balance the need to fund as many projects as possible with the need to increase the length and size of grant awards? How are colleges and universities handling cross-disciplinary research? Can NSF improve the way it reviews multi-disciplinary grant proposals? How do colleges and universities insure their research programs adapt to meet the needs of a changing marketplace?"

The Bill further explains the type of business partnerships and intergovernmental relations to expect and consider when making teams. As business professor Michael Porter recently said to BusinessWeek press, "Another big freight train is coming down the track in the U.S. economy. That's the tremendous long term shortage of labor we are facing. We're very short of workers of

any kind and particularly highly skilled scientists and engineers. So ways of bolstering the efficiency of people, such as the Internet, are important....." The pressure from appropriations to the press will only increase.

The press will seek to explain gaps in test scores, how districts exempt test takers, why extreme differences in scores occur in particular districts, financial differences between administrations and performance, teacher absenteeism, "emergency certifications" for understaffed schools, school safety, and administrative cheating on reporting school progress. Legislators know that pressure for higher education to "perform" will also increase, and may start looking for opportunities. Denver's "Governing Magazine" noted that it is politically easier to kick around Regents than a university, but also noted the director of the Western Interstate Commission for Higher Education says "rational governance" does not make much difference in performance, and makes his point with Michigan as a worst case administrative structure that performs very well.

The same publication later rated state governments in terms of financial management, capital management, human resources, managing for results, and information technology, and both Wyoming and Colorado were C students again! The Colorado voters restricted spending growth to 6%, and the magazine condemned these type ballot measures as "enemies of straightforward financial management." However Colorado is "well organized to cope with fiscal challenge" and has "far better planning than many others." Wyoming was cautious about spending after watching its budget estimates fail predictions three years in a row, and has averted difficulties. The magazine praised the state's cost accounting and the training they provide managers who are "encouraged to use it (cost accounting) on the job."

And finally, watch that smile Buckaroos, there is one last item! Technical scientific publishers are "tightening their grip on the lucrative science-journal market," according to The Economist. This captive, niche market is valued around $10 Billion dollars, and reportedly two large publishers have combined in spite of "fierce denunciations by academics, and serious efforts to undermine their business." Animals!? The article mentioned that subscriptions to "Brain Research" now cost a 'heady' $17,444! The interest group "Public Library of Science," has asked scientists to boycott publishers that will not relinquish publication rights of biomedical reports after six months. A new journal, designed by notables to compete with a prestigious Chemistry title, received more than 500 manuscripts in its first 100 days. Animals! Although the British competition authority has not yet cleared the combine, the big publishers are reportedly ready to "discuss a compromise."

Thanks–JET