A REVIEW OF THE LESSONS LEARNED AT THE CONFERENCES ON MAKING STATISTICS MORE EFFECTIVE IN SCHOOLS AND BUSINESS

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This paper reviews the principal lessons for statistics education for business that can be drawn from the 17 annual U.S. Conferences held so far called Making Statistics More Effective in Schools and Business. The series of Conferences was begun in 1986 under the leadership of Professors Harry Roberts and George Tiao, both of the Graduate School of Business, The University of Chicago. "The mission of the annual Making Statistics More Effective In Schools and Business (MSMESB) conference is to improve the teaching and practice of Statistics in Schools of Business. We aim to encourage interaction between business faculty and others involved in teaching business statistics to business students, as well as interaction with professionals from industry and government, with publishers, and with software producers."

INTRODUCTION
The first such conference was held June 20-21, 1986, at The Graduate School of Business, University of Chicago. The concept and design of the Conference was based on an earlier working conference to develop recommendations for the statistical education of engineers that Professor Robert Hogg had organized for July, 1984 at the University of Iowa, Iowa City, Iowa. A report of that Conference is summarized in Hogg (1985). In particular, the Chicago Conference was a working conference where most of the discussion took place in small groups or workshops. The 141 participants were a mix of academic statisticians and statisticians from industry, business, and consulting firms. Most of the participants were from the U.S. but there were representatives at that first conference from Australia, Canada, and the UK. Businesses represented included A. C. Nielson, Allied Corp., AT&T, Eastman Kodak, Educational Testing Service, Ford Motor Co., Hallmark Cards, Inland Steel, Joiner Associates, Northern Trust Co., SPSS, and Westat.
Objectives of that first conference were to address the following questions:
1. What kinds of statistical skills will be most useful to business school students in the years ahead?
2. How can statistical thinking contribute effectively to management and policy formation?
3. How can business schools best teach understanding of statistical thinking and proficiency in statistical skills?
4. How can statisticians be most helpful to faculty members in other professional areas within the school?
5. What are the opportunities for joint seminars and joint course development between statistics and areas such as management science and production?
In the end the conference concluded that there was a substantial consensus of dissatisfaction with the teaching of business statistics, especially as reflected in the poor selection of topics in popular textbooks and the limited opportunity for students to work with real data or make serious use of statistical computing.
With respect to curriculum, that first conference reached the following conclusions:
- Students are more effectively motivated by seeing statistics at work in solving real problems
- It is desirable to reduce emphasis on probability and formal statistical theory and to increase emphasis on applications
- Certain topics (then and now often omitted or treated lightly) such as time series analysis, statistical process control, experimental design, and sampling, deserve an expanded role
The importance of *statistical thinking* came up over and over again throughout the conference workshops.

THE EARLY CONFERENCES
    1987 New York University (featured speaker: Dr. W. Edwards Deming)
    1988 University of Wisconsin (featured topic: Quality)
    1989 University of Michigan (featured topic: Marketing)
    1990 University of Kansas
    1991 University of Pennsylvania (featured topic: Finance)
    1992 University of Tennessee (featured speaker: Dr. W. Edwards Deming again!)

WHAT HAPPENED IN THE EARLY DAYS?
- Worked hard on increasing our share of the internal market by improving teaching
- Learned about the fields of our colleagues outside of statistics
- Devoted considerable attention to quality management
- Devoted segments of conferences to doctoral studies in business statistics

WHAT IS STATISTICS?
    Contrary to what most textbooks said then (and now), statistics is not just the narrow study of making inferences to populations based on samples from those populations. A broader view is that statistics is the study of *processes* and what we can learn from observing them.
    Early concerns led to the writing of the textbook *Statistics for Business: Data Analysis and Modelling*, Cryer (1991), with a heavy emphasis on processes and quality. This book may have been too much of a change for many instructors, especially the many part-timers who teach business statistics. Other books have made more incremental changes. Without a doubt books have begun illustrating statistical ideas using more and more data whether real or realistic.

USING THE COMPUTER
    From the beginning Conference and to this day, appropriate use of technology in teaching (and doing) statistics has been a major theme.
    In Large Lectures
- Simulations
- Real-time Statistical Analysis
- Web applets
- Statistics in the News

    In Smaller Discussion Sections or Labs
- Simulations
- Real-time Statistical Analysis
- Activities
- Web applets

    CD-ROM and Web Site Resources
- Video Clips
- Animations
- Self-Testing and Review
- Outside of Class
- Homework
- Projects

MORE RECENT CONFERENCES
    1993 University of Minnesota
    1994 Rutgers University
    1995 California State University-Sacramento
    1996 University of Alaska-Anchorage
    1997 Pennsylvania State University
    1998 University of Iowa

1999 Babson College
2000 Syracuse University
2001 Rensselaer Polytechnic Institute
2002 University of Georgia

ON COMPUTER SOFTWARE

One of the most contentious issues dealt with in recent years is the possible use of Microsoft Excel software to teach, learn, and do statistics. Unfortunately, Excel is a very poor choice for that task. Here are a few reasons instructors put forth in favor of Excel:

- Ubiquitous (included with many computers)
- Familiar to business faculty
- Familiar to some students
  However, there are many more serious disadvantages:
- Poor Graphics (a majority of graph types should *never* be used: false third dimensions, bad histograms,...)
- Poor Algorithms (negative sums-of-squares, inaccurate results,...)
- Cannot handle missing data
- Poor Help Screens (false or misleading statements)
- Third Party Add-ins untested and *not ubiquitous nor free*

CONCLUSIONS

- De-Emphasize Mathematical Formalism
- Focus on Data Analysis—Real data, Hands-on
- Emphasis on Projects that gather real data to accomplish relevant goals like improvement of forecasting, quality, or productivity
- Use of Case Studies as effective simulations of real decision-making functions
- "Cover" Less (learn more!)
- Stress Effective Use Of Computing Throughout
- Apply Quality Management Ideas to Improve Teaching
- Write Better, More Effective, Textbooks and Multimedia Software

Much more information about the conferences, both past and future, may be found at the MSMESB Web site at http://weatherhead.cwru.edu/msmesb/.

REFERENCES
Cryer, J., & R. Miller (1991). *Statistics for business: Data analysis and modelling*. Boston: PWS-Kent.
Hogg, R. (1985). Statistical education for engineers: An initial task force report. *The American Statistician, 39(3)*, 168-175.