Department of Statistics, University of Wisconsin, Madison

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The University of Wisconsin Statistics Department commemorated its 50th anniversary in 2010. A gala celebration marked the event. However, the year when statistics was first introduced in the University of Wisconsin is unclear. Perhaps it was the establishment of a meteorological station in the 1850s in a building that was soon nicknamed "Old Probabilities". Perhaps it was in the Religion Department in the 1870s when they discussed Cross-validation. It certainly predated 1890, when George Comstock, the Director of Washburn Observatory, published a text based upon his course on the Method of Least Squares, targeted to "students of physics, astronomy, and engineering." The first page of that book shows an estimated density function; the second chapter was about "The Distribution of Residuals."

The next few decades were relatively quiet. Probability was taught in the Mathematics Department, including a course offered by Warren Weaver (faculty 1920-32). Henry Scheffé, who achieved later eminence at Berkeley with his classic book *The Analysis of Variance*, took Weaver's course. Scheffé received both BA and PhD degrees from Wisconsin and taught there from 1935 to 1937, but he taught only pure mathematics, not statistics. What statistics activity there was at the time was diffuse. There was some active statistical interest in the agricultural area, particularly in Agronomy where James Torrie was hired in 1940 as a red clover and soybean breeder. He and R. G. D. Steel published their book *Principles and Procedures of Statistics* in 1960. Courses were also taught in Economics and Business. A loose *Division of*

Statistics organization provided a cloak for such activities.

Why did little more happen until George Box arrived in 1959? We must look back to the curious events of 1940-1941, when a bold attempt to create a statistics program crashed and burned. In 1940 the University of Wisconsin invited Milton Friedman to visit the Economics Department with the specific charge of strengthening their statistical offerings. Friedman, who won a Nobel Prize in 1976 for his work on monetary theory and the consumption function, is now much better known as an economist. However, in 1940, he was more of a mathematical statistician. His PhD thesis advisor was the well-known Harold Hotelling, who later headed the Statistics Department at Chapel Hill, NC.

Friedman came to Wisconsin in Fall 1940 as a visiting Lecturer. He produced a detailed nine-page report on the dismal situation faced by a Wisconsin student interested in studying statistics, and he suggested the creation of a new Department of Statistics. He wrote:

> "A student cannot secure training at the University of Wisconsin sufficient to qualify him to teach advanced statistics or to do independent work in the field of statistical methods. Even if he takes all the work offered he will be but indifferently qualified to do research involving the application of modern statistics."

The administration was greatly impressed, and in the spring offered him a position as Associate Professor, charged to implement the program he had outlined. He indicated he would accept, but before the appointment could be approved by the Regents, a dispute broke out. A group of senior professors in Economics, led by Edwin Witte, demanded that the Regents cancel

the offer, claiming that, as able as Friedman might be, he was too young for such an appointment. He was, after all, merely a visiting lecturer! The students in the economics department backed Friedman. On June 3, 1941, Friedman decided he did not want to come where he was not wanted, and he withdrew to return to the National Bureau of Economic Research in New York and a subsequent career in economics.

Friedman emerged intact, but Wisconsin did not; it would be 18 years before a second attempt would be made. During the year Friedman was at Wisconsin, eighteen faculty members joined to form a Division of Statistics. The initial intention was to coordinate courses in statistics throughout the university and to supervise a minor in statistics. Among the initial members were A. B. Chapman, C. Eisenhart, J. H. Torre, F. A. Gaumnitz, and M. H. Ingraham. By the mid-1950's, when pressure for a broader set of statistical offerings was growing, Gaumnitz was Dean of Commerce and Ingraham was Dean of Letters and Science. Letters of support for a new department of statistics were gathered from several departments and colleges.

During the Spring of 1958, Stephen Kleene, Chair of Mathematics, approached Jerzy Neyman to see if he was interested in starting a new statistics department; nothing came of this. The administration then invited George E. P. Box, who was visiting at Princeton, where he headed the Statistical Techniques Research Group. With the support of the Dean of Engineering and the Dean of Letters and Science, Rudolf Langer, head of the Mathematics Research Center, offered George a one year visiting position. George came in 1959, was appointed Professor of Mathematics in January 1960 and formed the Department of Statistics in the Fall. He was on the faculty 1960-91, until his retirement.

George had years of experience in the practical benefits of statistical knowledge from his work with the British Army in World War II, and afterwards in the Dyestuffs Division of Imperial Chemical Industries in Manchester, UK. He had worked with scientists of all types; he was adroitly skillful in negotiating with all manner of potential partners; and he could personally demonstrate the enormous value that statistical applications could bring to research work. These skills facilitated the building of connections across the university and, in particular, did not arouse any defensive reactions such as those shown by senior economists in 1941. On the contrary, he was welcomed by all, and especially by the Division of Statistics members. The new department would not only teach the *science* of statistics; it would demonstrate that statistics could be applied to *practical problems* to the advantage of all participants. Therefore, an important feature in building up the faculty would be to make a number of joint appointments, with the cooperation of willing partner departments. Each such new appointee would thus have to be doubly acceptable. By the mid 1960's, George had developed a strong research program with members of the Chemical Engineering Department; this fueled work on non-linear estimation, including reaction models (Figure 1).

George Box's early appointments set the tone: John Gurland (1960-1987) and Norman Draper (1961-1999) were already in Madison, visiting the Mathematics Research Center. To this core were added three joint appointees, whose theses George had mentored at Wisconsin: George Tiao (1962-83), Business; W. G. (Bill) Hunter (1963-86), Engineering; and S. M. (Sam) Wu (1965-79), Mechanical Engineering. Subsequent hires in the 1960's, Jerome Klotz (1965-99), Gouri Bhattacharyya (1966-95), Richard Johnson (1966-2008), George Roussas (1966-76),

Stephen Stigler (1967-78), Grace Wahba (1967-) and Bernie Harris (1967-2002) strengthened the theoretical component of the department and led to its reputation for both strength and balance. The attached chart (Figure 6) shows how hiring progressed from there.

A consulting laboratory (StatLab) was created in 1966 with faculty member Don Watts (1965-1970) as the first head. The StatLab exposed our own students to the practical statistical problems encountered by faculty and students throughout the university and trained them to be useful consultants. This led to the idea of a visiting Statistician in Residence, an experienced person who would not only be able to help non-statisticians with their statistical problems but also provide a variety of statistical know-how to our students. One year appointments were made to J. Stuart Hunter (1967-68), Graham Wilkinson (1968-69), Don Behnken (1969-70), G. Morris Southward (1970-71), Harvey Arnold (1972-73), and Svante Wold (1973-74). Brian Joiner, co-creator of Minitab, joined the faculty in 1974 and ran the StatLab until he resigned in 1984 to form his own private consulting company. Asit Banerjee was hired after Joiner to run the StatLab, which closed around 1987.

The UW-Madison PhD dissertations in Statistics span a wide range of topics, from pure theory to development of applied methods, and in recent years there has been an increasing emphasis on statistical computing. Our PhD program has produced over 400 PhDs. Many of our graduates have held leading positions in academia, industry and government.

Around 1977-78, George Box initiated a major change, separating the PhD and the Masters Degree requirements. The courses, examinations and other requirements are now totally

separate. The masters program has evolved to require a one-semester consulting course and a week-long written and oral exam driven by scientists with real data problems. This masters program is highly regarded and widely emulated and has yielded over 500 MS graduates.

Our undergraduate major in statistics was for a long time a rather small affair. However, society recognizes the need of statistical reasoning and the jobs have emerged. Demand for BS degrees has followed, and our program has grown. Further, the recognition that statistics is an information science (or data science) has led to new collaborations and a continually increasing interest in statistics within our campus.

Research highlights from the early years include George Box's development of time series, first with Gwilym Jenkins and then with George Tiao. Box and Norman Draper made substantial advances in the theory of response surface designs and Draper and Harry Smith published one of the early regression texts that emphasized the study of residuals. Box and Tiao produced a classic work on Bayesian analysis that featured the analysis of real problems. Richard Johnson and Dean Wichern published their popular text on applied multivariate analysis and George Roussas authored a monograph that increased access to Le Cam's contiguity work. Grace Wahba began her series of publications on the statistical application of splines and Stephen Stigler emerged as an expert on the history of statistics with a series of articles, followed later by a book. The basic required mathematical statistics courses for graduate students, 709-710, were recast and improved by Gouri Bhattacharyya. Gouri later collaborated with Richard Johnson on a couple of introductory statistics texts.

The faculty's research work was published for many years in a series of red-covered technical reports, sent to a large mailing list. Most of them appeared subsequently in the peer-reviewed statistics Journals published by the major Statistical Societies. ASA and IMS meetings typically included several faculty speakers. The Department's early initial decades were thus an exceptional period of production and growth and it quickly became one of the top departments in the country. Greg Reinsel (1976-2004) became a leading researcher on time series and supported numerous students through his collaboration with George Tiao on decades-long analyses of stratospheric ozone pollution data and global warming temperature data. Greg's sudden death in 2004 while jogging shocked us all. Chien-Fu "Jeff" Wu (1977-90) conducted a very active research program in the design and analysis of experiments until he moved on to increased responsibilities elsewhere.

Grace Wahba (1967-), a member of the National Academy of Sciences, has been a world leader in the study of ill-posed problems. Tom Leonard (1980-95), Kam Tsui (1980-) and Michael Newton (1991-) enhanced the Bayesian component of the program both in teaching and research. Doug Bates (1980-2011) is an expert in non-linear estimation, and has been active in the development of the R statistical software language since its very beginning. In the late 1980s, Wei-Yin Loh (1982-) turned his attention to the design of classification and regression tree algorithms, ten years before the development of machine learning. Jed Frees (1984-97) held a joint appointment with the School of Business and Tom Kurtz (1986-2008) shared an appointment with the Department of Mathematics. Jun Shao (1996-) published a book on mathematical statistics which has become a standard reference. Richard Johnson (1966-2008)

was founding editor of Statistics and Probability Letters and served in that capacity for 25 years. Kjell Doksum (2002-2010) was a welcome addition for both our teaching and research program. Chunming Zhang (2000-) demonstrates wide expertise in model selection and functional analysis. Zhengjun Zhang (2005-) has been a pioneer in extreme value theory, with particular attention to finance applications. Yazhen Wang (2009-) focuses as well on financial statistics, with particular emphasis on long term memory processes. Zhiguang "Peter" Qian (2006-) works on design of experiments, computer models, the interface between statistics and optimization and statistical methods for high-technology. Bret Hanlon (2010-) studies variable selection and branching processes with a variety of applications.

Joint appointments with intimate connections to other scientific units of the campus were central to Box's vision for the Department of Statistics. Over the years, the joint appointment positions became concentrated in two programs, Biometry in the School of Agriculture and Life Sciences and Biostatistics in the Medical School. The Biometry program began in the late 1970s with Kim Andriano (1979-1981) and directed in its early years by Erik Nordheim (1977-). The program was strengthened by Brian Yandell (1982-) and Murray Clayton (1983-), and more recently by Bret Larget (2002-), Jun Zhu (2005-) and Cecile Ane (2006-). Murray Clayton was director of Biometry from 2005-2010, followed recently by Jun Zhu. The Biometry masters program is unique, as students are co-advised by a Biometry faculty member and their biology PhD advisor. Biometry faculty maintain active collaborations across the biology departments in agriculture, veterinary medicine and basic biological sciences, with considerable expertise in statistical genomics and spatial statistics.

John Van Ryzin (1969-79) led a group including John Crowley (1973-81) that strengthened research and consulting connections with medical faculty and scientists. The Biostatistics Program started from the UWCCC Biostatistics Shared Resource. Dave DeMets (1982-) was hired to oversee statistical activities in the Medical School, which evolved from division to center in 1986 and to department by 1991. Karl Broman (2007-), Rick Chappell (1990-), Jason Fine (1998-2008), Sunduz Keles (2004-), Christina Kendziorski (2001-), Michael Kosorok (1992-2006), Michael Newton (1991-), Barry Storer (1984-1996), and Sijian Wang (2008-) have enhanced and broadened the biostatistics program. A name change to the Department of Biostatics & Medical Informatics (BMI) in 1996 reflected the changing demands on this group. Recent collaborations between biostatistics and informatics faculty have risen from this wise pairing of complementary fields.

Statistics and BMI maintain close relationships. Graduate students in statistics and biostatistics reside in the same program, creating a unique synergy to the benefit of both departments. Most biostatistics faculty have joint appointments in Statistics, and several other Statistics faculty have affiliate appointments in BMI. One example of this blending is the leadership our campus plays in statistical genomics, with faculty from Statistics, BMI and Biometry building courses, training students and leading workshops in this emerging field.

Fifty plus years on from the department founding, we recall these and others who played vital roles in this exciting period. Some have died: John Gurland (1960-87), Bernie Harris (1967-2002), Jim Hickman (1972-93, joint with the Business School), Bill Hunter (1963-86, joint with Engineering), Jerry Klotz (1965-99), Greg Reinsel (1976-2004), Jerry Senturia (1972-78), John

Van Ryzin (1969-79) and Sam Wu (1965-79, joint with Mechanical Engineering). Retired faculty include Gouri Bhattacharyya (1966-95), George Box (1960-1991), Norman Draper (1961-99), Richard Johnson (1966-2008), Brian Joiner (1974-84), Bob Miller (1968-2005, joint with the Business School) and Bob Wardrop (1974-2006). Others have scattered near and far: Jim Bondar (1966-70), Don Watts (1965-70), Irwin Guttman (1962-70), Tom Leonard (1980-95), George Roussas (1965-76), Joe Sedransk (1969-1974), Stephen Stigler (1967-79), George Tiao (1962-83), and Chien-Fu Jeff Wu (1977-1990). Early visitors included J. Stuart Hunter (1960-61), and Gywylm Jenkins (1964-65). We fondly remember all of these colleagues.

Last, but certainly not least, we remember the office staff: June Maxwell (1961-63), Mary Ann Clarke (1962-94), Mary Esser (1963-97), Wanda Gray (1967-87), Gloria Scallisi (1988-2000), and Candy Smith (1970-2008) from past days, and all their successors, currently Nancy Brinkerhoff (2002-), Jude Grudzina (1997-) and Denise Roder (1997-).

We have had many stellar students over the years. Our 560 MS and 400 PhD degree graduates are scattered all over the world. We are deeply proud of them, even though we cannot claim credit for *all* their achievements. Many will remember the outrageously funny student-faculty Christmas skits, which were featured at George Box's annual Christmas party for many years. The students made fun of the faculty, and vice versa. For example, one such offering featured "an all star cast plus Brian Joiner". Another had the ambiguous line, "The students are revolting".

The Department has resided in four different physical locations over the years. Initially,

we occupied a three-bedroom house on Johnson Street. George Box and Norman Draper each had a bedroom while the first four students occupied the master bedroom. June Maxwell (Figure 2) ran the Statistics Department from the ground floor as its Secretary for the first years, demonstrating great ingenuity in tackling the many teething problems that inevitably arose.

When our old house was demolished for a new building on the site, we moved to a rented set of small apartments above Tiedeman's drug store at 710 University Avenue at Lake Street. The building was owned by three very nice elderly sisters, two of whom were badly handicapped. The university tried to take over the building in those early days but the sisters (now dead) prevailed in court. Our second floor space, shared with another department consisting of one professor and his secretary, had many bathrooms and one large six-sided lecture room where George Box once jokingly confided a secret "just between these six walls". Within those same six walls, a student taking his final Ph.D. orals responded impatiently to one of the examiners, "That's a *silly* question." The ensuing explosion and uproar required a 10-minute break, with the candidate sent into the corridor. After offering an apology, he passed, and later had a successful career in another country.

Figure 3 shows (partly) the Computer Science and Statistics Center, our third building, which we shared with Computer Science. Initially the two departments were mixed together, but little cooperation was generated. As Computer Science expanded rapidly, stages 2 and 3 of the building were added, but when the site was filled entirely, Statistics was expelled to the former main city hospital at 1300 University Avenue in 2004. We now occupy a strange series of separate and/or nested rooms that remind us nostalgically of those above Tiedeman's drug store.

Appropriately, we live in a veritable distribution of offices. No boring same-size offices for *us*.

Figure 1 shows our founder George Box in class in the 1960's. Note the suit and tie in more formal times. On the board is the famous A → B → C example of nonlinear estimation in reaction models. As we write this, George is in his 90's. Many of our former students have reminisced about George's "Monday Night Beer Sessions" held in the basement of his house, during which a speaker, most often from another field, would informally introduce a research problem he or she was studying, and would then be involved in a general discussion of how statistical methods could impact the research. "I learned more in those sessions than I did in regular class" is a sentiment often heard expressed by our alumni.

Wisconsin statistics faculty wrote many important books that had worldwide sales over many years. Among these were: *The Future of Statistics* (Watts, ed. 1968); *Evolutionary Operation: A Statistical Method for Process Improvement* (Box and Draper, 1969); *Contiguity of Probability Measures: Some Applications in Statistics* (Roussas, 1972, digital version 2008); *A First Course in Mathematical Statistics* (Roussas, 1973); *Statistical Concepts & Methods* (Bhattacharyya and Johnson, 1977); *Statistics, Principles and Methods* (Bhattacharyya and Johnson, 1984); *Nonlinear Regression Analysis and Its Applications* (Bates and Watts, 1988); *Spline Models for Observational Data* (Wahba, 1990); *Bayesian Inference in Statistical Analysis* (Box and Tiao, 1992); *Time Series Analysis* (Box, Jenkins and Reinsel, 3rd ed., 1994); *Statistics for Business: Data Analysis and Modelling* (Cryer and Miller, 1994); *The Jackknife and Bootstrap* (Shao and Tu, 1995); *Practical Data Analysis with Designed Experiments* (Yandell, 1997); *Business Statistics – Decision Making with Data* (Johnson and Wichern, 1997); *Applied*

Regression Analysis (Draper and Smith, 3rd ed. 1998); *Statistical Reasoning and Methods* (Johnson and Tsui, 1998, alternate edition, 2003.); *Mixed Effects Models in S and S-Plus* (Pinheiro and Bates, 2000); *Mathematical Statistics* (Shao, 2nd ed. 2003); *Statistics for Experimenters* (Box, Hunter and Hunter, 2nd ed., 2005); *Data Monitoring in Clinical Trials: A Case Studies Approach* (DeMets, Furberg and Friedman, 2005); *Mathematical Statistics: Exercises and Solutions* (Shao, 2005); *Response Surfaces, Mixtures and Ridge Analyses* (Box and Draper, 2nd ed., 2007); *Applied Multivariate Statistical Analysis* (Johnson and Wichern, 6th edition, 2007); *Introduction to Statistical Methods for Clinical Trials* (Cook and DeMets, 2008); *Fundamentals of Clinical Trials* (Friedman, Furberg and DeMets, 2010); *Probability and Statistics for Engineers* (Miller and Freund, 8th ed., 2011 but revised by Johnson since the 4th ed).

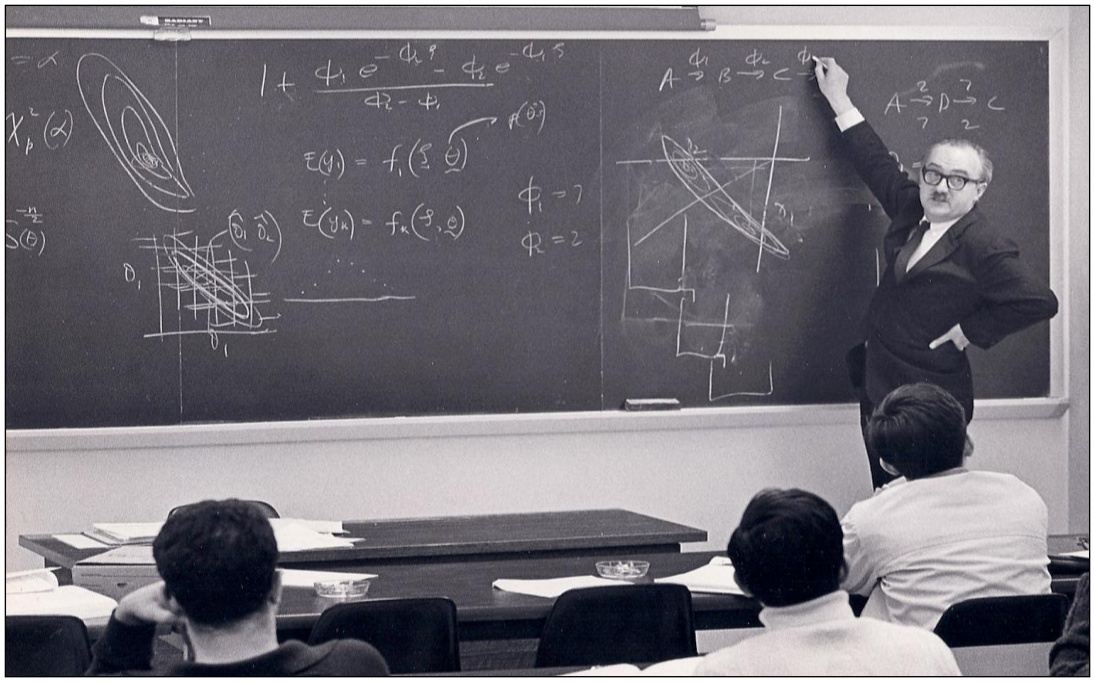
Sadly, we don't have complete pictures of the department. Figures 4 and 5 show some faculty from the 25th and 50th anniversary gatherings, respectively. Figure 6 shows all faculty ever in the UW-Madison Statistics Department. See our web page (www.stat.wisc.edu) for current regular and affiliated faculty, and for a collection of historical pictures.

The succession of chairs of the Statistics Department is: George E. P. Box (1960-9), Irwin Guttman (1965-6), Norman Draper (1968-73, 1994-7), George Tiao (1973-5), John van Ryzin (1975-7), Gouri Bhattacharyya (1977-9), John Gurland (1979-81), Richard Johnson (1981-4), Robert Miller (1987-91), Douglas Bates (1991-4), Greg Reinsel (1997-2001), Erik Nordheim (2001-5), Jun Shao (2005-9), Kam-Wah Tsui (2009-11), Brian Yandell (2011-).

While in Wisconsin, some of our faculty have been society presidents: George Box

(ASA, 1978; IMS, 1980); Tom Kurtz (IMS, 2006); Jun Shao (ICSA, 2007). We have also had several editors of journals: Doug Bates (core development team of R, *Current Index to Statistics*, 2001-2003); Richard Johnson (*Statistics & Probability Letters*, 1985-2010); Brian Joiner (*Current Index to Statistics*); Michael Newton (*Annals of Applied Statistics*, 2006-2009); Jun Shao (*Journal of Multivariate Analysis*, 2002-2005, *Sankhya*, 2002-2007); Brian Yandell (*Amstat Online*, 1999-2002).

1. George Box discussing nonlinear estimation with attentive students (1960s).



2. Our first secretary, June Maxwell (1961-3).

3. The Computer Science and Statistics Center, 1210 West Dayton Street (1967-2004).

4. Statistics Department 25th Anniversary. George Box is flanked by Claire Box and Dennis Cox. Rich Johnson and his wife Bobby are behind, as are Bob Wardrop, Thomas Wehrly, Tom Leonard, Ian Hau, Connie Shapiro (Page), David DeMets, Kam Tsui, Kyungmann Kim, and Doug Nychka.

5. 50-Year Anniversary Organizing Committee (June 3-4, 2010). From left, Kjell Doksum, Grace Wahba, Jun Shao, Kam Tsui, Rich Johnson, Brian Yandell, and Kyungmann Kim.

6. History of statistics faculty at UW-Madison