THE ROLE OF THE AMERICAN STATISTICAL ASSOCIATION IN STATISTICS EDUCATION

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As a leader, the American Statistical Association is heavily involved in statistics education, both in terms of content and pedagogy, and also for professionals who need continuing education and further professional development. The Center for Statistics Education exists to assist in curriculum development for kindergarten through graduate levels, and to develop and manage programs, which promote the teaching of statistics, assist in teacher preparation and provide resources for teachers of statistics. The Center also provides educational opportunities in various applied sub-fields of statistics for professionals, and supplies career information to prospective students of statistics as a way to build the profession and meet the statistical needs of society. In collaborations with publishers, it has also developed a series of publications to aid quantitative literacy at different levels.

INTRODUCTION

One of the major goals of the American Statistical Association (ASA) is the shaping of statistical education. The methods of achieving this goal have developed through years of experience, research, patience, and teamwork. With every step we feel closer to the goal yet there is lot to be done. The ASA has been on the front line in terms of development of educational initiatives.

The ASA was founded 161 years ago as the American Statistical Society before it went through the name change. For most of its life though the association has been known as the American Statistical Association. During last 150 years, other associations/institutes were formed with the emphasis on research in statistics, but to date the American Statistical Association remains the largest of them all.

The ASA plays a multifold role in helping develop statistical education. Statistical education in K-12, undergraduate, graduate, professional and continuing education are broad categories of classification that we would like to discuss. The needs of each category are different and the approaches provided are suitable for the needs. A Center for Statistics Education (CSE) was established to oversee and centralize different ongoing efforts for betterment of statistical education and develop new directions and methods. More information about the extensive involvement of ASA in statistical education is available on the ASA's web site at http://www.amstat.org/education/.

K-12 EDUCATION

Several programs suitable for kindergarten through high school education have been developed and more are being planned. Statisticians have worked for years with legislators and education specialists to incorporate statistics in the K-12 curriculum. As a result of these efforts, in most states, statistical tools and methods have been incorporated in mathematics courses. Many high schools are offering courses in statistics, some at two levels, basic statistics and Advanced Placement (AP) statistics. Successful completion of the AP statistics exam earns students credit in many colleges and universities. Advanced Placement program is a cooperative effort of secondary schools, colleges, and the College Board. Through this program college level courses and examinations in several subjects are available for high school students. About 845,000 students took 1.4 million AP exams last year in 35 different courses. From 1997 to 2001, the number of students taking AP Statistics exam increased from about 8,000 to 42,000.

The *K-12 school membership program* invites schools to become members of the ASA. A one-year membership subscription entitles the subscribing school to *Chance Magazine, STATS: the magazine for Students of Statistics*, *the Statistics Teacher Network Newsletter* as well as the yearly directory *of Schools Offering Degrees in Statistics.* These schools also pay much reduced

membership dues, lower than the institutional membership dues, even lower than the individual membership dues. The publications provide teachers of statistics in high schools with some teaching materials, information about professional development, and information useful to help students make decisions regarding future educational opportunities.

Another program developed by ASA is the *Adopt-a-School program*. The purpose of this program is to enable professional statisticians to help schools in their efforts to include statistics in the curriculum. Many teachers are enthusiastic about bringing quantitative literacy to their classrooms, but lack the background and formal training to do so with confidence. Statisticians make contact with teachers and administrators to arrange visits to the classroom. Key to the success of this program is the statistician's close work with the classroom teacher. Teachers welcome the assistance of professionals in the field. In 1992, twelve local ASA chapters were chosen to test this program. Using sets of materials sent out from the ASA office, the chapters began trying out the program. In 1993, twenty-three more volunteers received updated versions of the materials and began similar activities. Since then, statisticians have continued to work with teachers at many schools. The program was originally intended to be a chapter-level activity. Some chapters made wider use of the materials than others, involving several chapter members and several schools. Others had effectively one-person one-school experiment.

The ASA is interested in promoting the use of data analysis, statistics, and probability in the classroom. Thus emerged a series of programs called *Quantitative Literacy (QL*). ASA has developed a series of QL programs serving elementary, middle, and secondary grade levels. These programs have prepared materials and a workshop format that are used to instruct teachers in these areas and present fun, hands-on ways for them to teach their students. ASA's Center for Statistics Education (CSE) helps those interested in bringing QL to teachers with the necessary arrangements. Information about the funding opportunities and other aspects are available on the ASA's web site. In the QL series, programs such as Bring QL to your teachers, QL publications, QL classroom projects, QL workshops for elementary, middle school, and high school teachers, AP statistics workshops, and more are available.

ASA has developed several *publications* promoting statistical concepts and education. The *Statistics Teacher Network* is a joint venture of ASA with NCTM (National Council of Teachers of Mathematics). The newsletter is published three times per year. Several publications such as *Guidelines for Teaching Statistics, Mathematics in a World of Data, Probability Through Data, Exploring Projects, Exploring Linear Relations, Advanced Modeling and Matrices* are available from Dale Seymour Publications. ASA also publishes two magazines that promote statistical concepts. *STATS: The Magazine for Students of Statistics*, provides practical educational and career information, often from students themselves, lively accounts of statisticians at work, and topical examples of statistically challenging problems in everyday life. *CHANCE,* a quarterly magazine published with Springer Verlag NY Inc., is a general interest publication featuring the application of statistics to topical issues and problems – from political polling to toxic waste to sports statistics. In addition, ASA publishes a variety of brochures such as *Minorities and Statistics, Careers in Statistics, Women in Statistics,* and *Surveys and Privacy*, available free of charge in small quantities, and for a small charge for large quantities. The *Journal of Statistics Education* (JSE) is an online publication featuring teaching methods and methods for improvement of conceptual understanding of statistics.

K-12 teachers are encouraged to participate in ASA's annual *Poster and Project Competition*. Teachers encourage and direct students, either solo or in groups to prepare entries for this competition. Local statisticians also help in the process. A committee of distinguished statisticians and dedicated teachers of statistics meet in May each year to evaluate entries. The deadline for both contests is April 15, annually. Winners receive cash awards and ASA certificates for their efforts. These posters are also displayed at the annual Joint Statistical Meetings (JSM) in August every year. A statistical project is the process of answering a research question using statistical techniques and presenting the work in a written report. A statistical poster is viewed as a display containing two or more related graphics that summarize a set of data, look at the data from different points of view, and answer some specific questions about the data. The number of entries in these competitions has grown to almost 2000 in a short period of time.

To provide teachers of statistics with exemplary practices and materials to enhance their understanding of content of the AP course, to enable to cover content of AP syllabus more effectively, and encourage them to try innovative forms of teaching to meet the needs of their students, ASA has developed *AP Statistics workshops*. The AP syllabus covers most of the topics taught in a college level introductory statistics course based on modern data analysis. The course also emphasizes the use of appropriate technology for graphical displays and computation, and use of hands-on activities to teach concepts. ASA also offers *Beyond AP Statistics*, a course for experienced teachers. It covers statistical topics that extend beyond the AP syllabus thus enriching teachers' understanding of statistics enabling them to better instruct their students and preparing them for further studies in the discipline.

The *Curtis Jacobs Memorial Prize* was established in 1991 to honor the memory of a former statistician of the U.S. Bureau of Labor Statistics. Mr. Jacobs served as the chief statistician on many major Federal economic statistics programs, including the Consumer Price Index, which measures the rate of inflation in the American economy. The Jacobs Award program provides encouragement for students to gain an understanding and appreciation of surveys and their uses, appreciate strengths and weaknesses of statistics reported in the press and elsewhere, gain understanding of how surveys are taken and how results are reported. High school or middle school students in the Washington, D.C. area participate in the competition. Their projects may focus on the role of sample surveys as a way of gathering information for making decisions, as a way to make comparisons among groups, or as a way of collecting data for analyzing trends over time. All entries are judged based on the creativity in the choice of objectives and topics, understanding of the steps needed to conduct a survey and proper execution of steps, selection of appropriate sample selection methodology, thoughtfulness and ease of questionnaire design, and analysis. The winning team receives $200 in U.S. savings bonds, and an invitation to the Washington Statistical Society's annual dinner where the prize is awarded. The supervising teacher receives a plaque and the school receives a one-year free school membership to ASA.

UNDERGRADUATE EDUCATION

The ASA endorses the value of undergraduate programs in statistical science, both for statistical science majors and for students in other majors seeking a minor or concentration. ASA has developed curriculum guidelines for undergraduate programs in statistics. These guidelines describe the skills needed (statistical, mathematical, computational, non-mathematical, and substantive area) by the graduates, curriculum topics (statistical, mathematical, probability, computational, and non-mathematical) that the program should include, electives, and practice. Many detailed recommendations on statistics programs, along with a list of model programs are developed and maintained by the Section on Statistical Education, in conjunction with other sections and committees of ASA.

To promote undergraduate statistics education with the goal of improving the future workforce, a committee of ten representatives from academia, industry and government met in 1999 to consider what might be done to foster the growth of undergraduate education in statistical science. One of the outcomes of the meeting was to define vision and mission statements for the ASA initiatives. The vision for the Undergraduate Statistics Education Initiative (USEI) is to create opportunities for students to avail themselves of sound undergraduate educational programs in quantitative reasoning, to give them a broad quantitative foundation for further study in specialized disciplines, and to increase quantitative literacy within the modern workforce. The mission of USEI is to expand and improve undergraduate statistical education, to organize symposia and workshops to create guidelines for programs, to market the potential for programs in and products of statistical education, to support the continuing development and delivery of modern statistics curricula. The first symposia was held at JSM 2000, in Indianapolis titled *Improving the Workforce of the Future: Opportunities in Undergraduate Statistics Education* prior to JSM. Approximately 150 attendees took advantage of this opportunity. Each presentation was followed by discussion from the floor with team members responding to questions. The relevant information and documentation is available on the ASA web site at http://www.amstat.org/education/usei.html.

ASA has also compiled and made available information about example programs in statistics, schools offering degrees in statistics, internships available, scholarships, and awards, etc. Such information, compiled in one place, is useful for teachers in advising students in career opportunities, and for students in developing their careers in statistics. ASA also compiles information on career opportunities, professional opportunities, and job availability, and makes it available on the ASA's web site as well as through publication of *Amstat News*.

In September 2000, ASA published its first career issue of *Amstat News*, the membership magazine of the American Statistical Association. This issue contains Statisticians in history, A day in the life of a statistician (described by several statisticians working in diverse areas), The future of statistics, Career corner: What we do with degrees in statistics, Preparing curriculum vitae, Finding jobs in statistics, etc. Again in September 2001, a career issue was published, and judging from the response received, ASA will continue to publish career issues of *Amstat News* in future.

GRADUATE EDUCATION

ASA maintains an extensive list of graduate programs in statistics. Every year ASA conducts a survey of statisticians and compiles information about the their salary distributions. For example, salary distributions in academia are classified by the type of institution (4-year or research), number of years of service by the faculty, and faculty position (assistant, associate, or full professor). This information is useful in promoting graduate studies in statistics, in hiring decisions by administrators, and in making career decisions by students.

ASA published several journals that include research papers. These journals emphasize different objectives as well as different areas of statistical sciences. For example, the *Journal of Agricultural, Biological, and Environmental Statistics (JABES)* aims to develop the interface between statistics and the biological sciences with emphasis on agriculture, biotechnology, the environment, and natural resources, the mission of *Technometrics* has been to contribute to the development and use of statistical methods in the physical, chemical, and engineering. The *Journal of Statistics Education* disseminates knowledge for the improvement of statistics education at all levels, including elementary, secondary, post-secondary, post-graduate, continuing, and workplace education. Additionally there are other publications such as the *Journal of American Statistical Association*, *Journal of Business & Economic Statistics*, *and* the *Journal of Computational & Behavior Statistics* aimed at specific groups.

PROFESSIONAL DEVELOPMENT AND CONTINUING EDUCATION

No matter what profession we adopt, to be successful in our profession there is a need for continued professional development, whether it is to learn about the subjects/topics that were not part of the formal degree program, or to learn about applications of newly developed methods useful in the job. Teachers are always looking for the latest teaching methodologies, projects, hands-on-activities, etc. Considering how fast the technology is changing and its deep impact on how we do statistics, statisticians are on the lookout for the latest technological developments geared to do statistics. Many companies provide on-site-training if the formal education is lacking in certain components needed to carry out job. Recognizing this need ASA took a leading role in providing professional development and continuing education.

Needs for professional development depend on a person's educational background, type of work, and job requirements. There are many careers in statistics, and the job title may not include "statistician". The educational backgrounds of statisticians vary depending on the type of job. For example, most high school teachers of statistics are mathematicians by training. Many had no formal training in statistics. Many probably had one or no course in statistics in their degree program finished many years ago. Some are self-taught statisticians out of sheer interest for statistics, while others get statistics course thrown in their lap whether they want it or not. In either case, these teachers need help in understanding concepts, and devising teaching methods. In colleges statistics courses are not necessarily taught within the mathematics or statistics department. As a result, the educational background of college teachers varies from mathematics, statistics, to psychology to business. Many statisticians are employed by private industries and

federal and state governments. Their backgrounds vary depending on the type of job, from quality assurance to clinical trial specialist.

For years, the ASA has been developing professional development activities to satisfy needs of different job types. Such activities include conferences, courses, workshops, on-job-training, videos, professional conferences, and videoconferences. Assuming a leading role, the ASA established a Center for Statistics Education (CSE). Several committees were established to assist and advise the center in developing and implementing educational programs. The Advisory Committee on Continuing Education (ACCE) is charged with advising the ASA Center for Statistics Education in its mission to provide continuing education services to ASA members. The CSE is certified through the International Association of Continuing Education and Training (IACET). IACET is an internationally recognized organization for standards and certification for continuing education and training. This organization ensures quality in continuing education through its programs, publications, and research, and aids ASA in meeting its criteria and keeping in compliance.

Conferences provide an excellent opportunity to share ideas, experiences and knowledge with others. ASA organizes one big annual meeting known as Joint Statistical Meetings (JSM) every August with help from five other sister societies/organizations. Institute of Mathematical Statistics (IMS), International Biometric Society's Eastern North American region (ENAR) and Western North American region (WNAR), and Statistical Society of Canada (SSC) are partners of ASA in this joint venture. This is a big event with approximately 4,000 attendees converging at the conference venue from all over the world to share their knowledge with others. The conference venue changes from one part of US to another every year. Since ASA partners with SSC, about once a decade the joint meeting is held at some location in Canada. The JSM offers over 25 parallel sessions for four days. Invited and contributed presentations, poster presentations, round-table meetings provide multitudes of opportunities for professional development. ASA also sponsors regional special topics meetings. These are on smaller scales than the JSM with typical attendance around 200. Sections of ASA are more active in organizing and assisting in special topics' conferences. ASA also works with other organizations such as NCTM in developing programs at their meetings.

ASA offers *Continuing Education (CE) activities* at JSM and outside. Although a major thrust of CE is at JSM, the CSE also takes the show on the road under the umbrella program called LeanSTAT. The CSE identifies locations around the country with the need for education in specific topics and matches them with leading statisticians. The CE program by ASA has evolved over quarter of a century through ideas and hard work of dozens of volunteers. CE was first discussed in 1974 and the first short course by George Box and George Tiao was offered at the Annual Fall Technical Conference. In 1975, the first short course at the Annual meeting was established. During a five-year period from 1977 to 1981 the Board of Directors discussed development of a full-fledged CE program. As a result of these extensive discussions, in 1981 the Board of directors approved a plan for ASA's CE program and charged ACCE with development, management, evaluation, and cataloguing of the CE program. And thus started the tradition of CE at JSM. Over the years, the nature of CE at JSM has evolved with the aid of different ideas and changing needs of the statistical community. The CE at JSM consists of one invited 2-day course, other 1/2-day and 1-day courses, 1/2-day and 1-day workshops, and 2-hour Computer Technology Workshops. Over the last ten years, at JSM the number of offerings has increased to 40 CE events with approximately 1,400 participants in these events.

The LearnSTAT program was created as an extension of the CE program at JSM. It offers professional development opportunities in statistics outside JSM, throughout the year at various locations. The LearnSTAT program offers 1-day and 2-day Courses & workshops around the country. Sometimes companies invite ASA and offer their facilities for such workshops, thereby providing CE opportunities to their employees without spending time on travel.

For the past five years, the Council of Chapters (COC) has offered a program called the Traveling Course for its member chapters. Every year, two or three leading statisticians with topics in demand are identified and invited to make a three-day tour visiting three selected chapters to give half-day workshops. All chapters are encouraged to apply for one or more courses to provide CE opportunities to their members. A traveling course committee selects

chapters to receive the traveling course from requests based on the perceived impact and need. Selected chapters make all the local arrangements. ASA charges $25 per attendee to cover the travel expenses of the presenter. Every year ASA videotapes short courses on current topics taught by leading statisticians. These videotapes are available for rental or purchase. Lecture notes are also available along with these videotapes. Many chapters and sections use them for their continuing education activities. Information about the ASA's professional development activities is available from ASA's Amstat News, ASA's dateline, ASA's web site - http://www.amstat.org/education/, and different Chapter/Section web sites.

In summary, ASA has been a breeding ground of ideas for the development and improvement of statistical education in the United States. Being the largest and oldest association on the continent, it stands like an old and strong tree providing shade for those who need it. It uses its well-established web of chapters and sections to spread the message of statistical education and implement many policies. ASA has always communicated with other organizations in the continent and the world, received help from them and advanced assistance. It will continue to assume a leadership role as long as possible.