Stats

The Magazine For Students Of Statistics • Spring 1998 •

Public Statistics Day: A Worthwhile Experience

Making the Grade— AP Statistics, 1997

Iowa Roars to the 1997 College Bowl Crown

Student Voices

Spring 1998
Number 22

The Magazine For Students Of Statistics

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Cover photo flStudents participate in an activity led by Fred Djang during the 1997 Public Statistics Day (page 3).

Features

Departments

Editor's Column

Statistical Education

Christine McLaren

Dear *STATS* Readers:

In this issue we focus on the theme of statistical education. ASA President, David S. Moore, recently wrote that "outreach on behalf of the profession is an essential function of the society" (*Amstat News*, March 1998, p. 10). Public Statistics Day, held in conjunction with the Joint Statistical Meetings is one important ASA outreach function. Through hands-on interactive activities, kindergarten, elementary, and middle school students have fun learning about statistics! In our first feature article, "Public Statistics Day: A Worthwhile Experience," Roxy Peck quotes from a letter written by one happy student participant, Ha Ngayne. "Dear ASA, Thank you for a fun field trip … I had so much fun putting the eyedrop on the penny and counting the M&Ms … When I grow up, I want to be a teacher." Expert teacher, Fred Djang, led the session that Ngayne attended, "The Planet Earth and Us." He gives us a very lively description of the interactive class, tailored for elementary and secondary students. It is easy to see why the session proved to be so popular.

According to Past-Chair of the Advanced Placement Statistics Test Development Committee, Rosemary Roberts, "In the United States and Canada, statistics is not usually offered at the secondary school level. However the recent introduction of an Advanced Placement Statistics course and examination will provide an opportunity for secondary students to pursue and receive credit for a college-level statistics course." (*International Association for Statistical Education News*, May 23, 1996, p.1.) We are delighted to feature an article by Richard L. Scheaffer, "Making the Grade—AP Statistics, 1997." Chief Faculty Consultant for the Test Development Committee, Scheaffer tells of the amazing success of the first exam ever offered in statistics. Approximately 7600 high school students sat for the exam in 1997. Scheaffer notes that statistics grades on the exam appear to be in line with grades from other AP exams in mathematics and sciences, including Calculus, Biology, Chemistry, and Physics. He concludes that "AP Statistics has made the grade and will remain a solid member of the AP family." For our readers eager to test their skills, a portion of the 1997 exam is included in the Appendix to Scheaffer's article.

The College Bowl is an ASA student activity held during the Joint Statistical Meetings. Don Edwards and Mark Payton have described this "fast-paced, light-hearted competition" for teams from graduate programs in statistics (*STATS*:18, 1997, p. 17). They noted that "this is a great opportunity for students and faculty across the country to mix and have fun and learn a thing or two about statistics in the process." In this issue, Edwards and Payton showcase the success of the 1997 competition, "Iowa Roars to the 1997 College Bowl Crown." Teams representing seven graduate programs competed: Baylor, Brigham Young, Iowa, Iowa State, Nebraska, University of California-Santa Barbara, and University of California-Riverside. I suspect that members of the winning team from Iowa are busy boning up for this year's competition to defend their title!

A statistical internship is an excellent way to gain exposure to real-world problems and to develop statistical skills. Graduates from Messiah College in Grantham, Pennsylvania, Amy J. Heffelfinger, Brenda R. Horst Phillips, and Melanie B. Wigg, share details of their internships at the Center for Biostatistics and Epidemiology at Penn State's College of Medicine. They found that exposure to cutting edge biomedical research reinforced their classroom experiences and prepared them for further study.

As we near the end of the academic year, a typical question on the mind of many students is, "What am I going to do after I graduate?" Anticipating this, Dr. STATS has assembled a distinguished panel of statisticians to share their views on how to get a job in industry (Bruce E. Rodda and Gary C. McDonald), academia (George Casella) or government (Peter A. (Tony) Lachenbruch, and Geraldine Stevenson). This article contains many helpful hints to help you prepare for a successful job search.

In Issue 22, we also hear from Jane Booker, group leader of the Statistics Group at Los Alamos National Laboratory in New Mexico. Booker describes the exciting scientific/engineering environment at "one of the world's most respected research and development institutions." Clearly Booker has a challenging job as her projects require development and application of techniques using empirical Bayes methods, Markov chain Monte Carlo, uncertainty analysis, data pooling and data mining. Don't forget to read this issue's "Outlier...s." Mark Glickman will entertain you with another of his famous parodies, "Probability Man," based on Bob Dylan's classic, "Tambourine Man."

We hope you enjoy this issue dedicated to statistical education for all levels. In the words of David Moore, "Every educated person should be acquainted with statistical reasoning." (*Statistics, Concepts and Controversies*, New York: W.H. Freeman, 1997, p. xvii.)

Yours Sincerely,

Christine McLaren

Public Statistics Day: A Worthwhile Experience

1. Preface

Public Statistics Day 1997 was a great success thanks to dedicated volunteers who made learning statistical concepts fun for 135 Anaheim school kids. Conceived and implemented by Cathy Crocker and Sue Kulesher of the ASA staff, Public Statistics Day is designed to promote the public image of the discipline and to allow statisticians to share their enthusiasm for statistics with children from kindergarten through middle school. The program is coordinated with the Joint Statistical Meetings, and this year's event will be held in Dallas.

The success of the 1997 program was the direct result of the extraordinary efforts of our volunteer instructors from academe and industry, Fred Djang, Dan Holder, Lifang Hsu, Ruth Ann Killion, Heather Smith, Naitee Ting, and Linda Young, and the financial support of corporate sponsors General Motors, Hoechst Marion Roussel, Lilly, Merck Research Laboratories, Wyeth Ayerest Laboratories, the ASA, and the Anaheim Marriott.

Last year, instructors were asked to make their sessions activity-based and highly interactive, and some great sessions were delivered. Kindergarten children made stem-and-leaf displays with stickers and jumped in the Marriott hallways to collect data to help them decide if taller kids can jump farther than shorter kids. Third graders conducted an experiment to see if the number of drops of water that can fit on a penny depends on whether there is dish soap in the water, fifth graders conducted a survey of shopping preferences, and groups of middle school kids took off for the Marriott lobby

Fred C. Djang

to attempt census counts. These are just a sample of the type of sessions that filled the morning. Each student participated in three different sessions.

The students had fun with statistics, and more importantly learned from the day's experiences. One of the teachers who accompanied a third grade class later wrote:

> *"It was a great pleasure participating in the statistics workshop. My children were mesmerized by the whole experience... We followed up in our classroom with charting and writing about all we learned. The statistics provided us with interesting topics for discussion among my third graders. My children are bilingual and welcome the opportunity to gain new vocabulary in English. There were many surprises in the discoveries they made about measuring and probability..."*

We also received letters and pictures from

Fred Djang is a current member of the AP Statistics Development Committee. He has taught mathematics at Choate Rosemary Hall for the past 18 years, and he has been a part-time biostatistician at Bristol-Myers Squibb pharmaceutical company for over 10 years. A long time table leader at the AP Calculus reading, Djang is also on the advisory panel for the American Mathematics Competitions. He has taught AP calculus for over 20 years and AP statistics more recently. An AP consultant for the College Board, he has taught numerous AP workshops to teachers in both calculus and statistics. Djang is past-president of both the Connecticut Chapter of the American Statistical Association and the Connecticut Independent Schools Math Forum.

Roxy Peck is the associate dean of the College of Science and Mathematics and a professor of Statistics at Cal Poly, San Luis Obispo. She is co-author of two statistics textbooks: Statistics: The Exploration and Analysis of Data *(Third Edition) and* Introductory Statistics *(Second Ediction). Peck is an associate editor for* The American Statistician, *faculty coordinator for the 1997 National Public Statistis Day (an annual event for K-12 students sponsored by the ASA), and the project director for the 1995-97 NSF funded project titled "Improving Statistics Education: Faculty Enhancement through Collaboration with Industry".*

many of the students who participated in the day. One student, Ha Ngayne, wrote:

"Dear ASA, thank you for a fun field trip. I really enjoyed the cookie and the juice. I had so much fun putting the eyedrop on the penny and counting the M&Ms— red, yellow—and the thing that I like the most is 'The Planet Earth and Us.' I hope we can come back soon. I was so surprised. When I grow up, I want to be a teacher. From, Ha Ngayne."

In the article that follows, Fred Djang relates his experiences with Public Statistics Day and describes his session "The Planet Earth and Us" (the one that Ha liked so well). I hope that it will inspire you to get involved with this wonderful day as an instructor or corporate sponsor. ***—Roxy Peck***

2. Introduction

A statistics presentation for middle school students and second graders, what was I to do? From my teaching experience, I knew that in order to make the presentation interesting and meaningful to young people, it must tell a story, be current, and activity-based. After much thought, I settled on the title, "Our Planet Earth and Us," to introduce three important concepts in statistics; estimation, graphical representation, and bias. I planned to illustrate estimation in two ways. First, I would display a jar of candies and let students guess how many were in the jar. This yields results with a lot of variation but not necessarily bias. Second, I would use inflatable plastic globes to estimate the proportion of land (water) on Earth. This will turn out to overestimate the amount of land and underestimate the amount of water. It produces a biased estimate. Throughout the talk I would make several references to the idea of UFOs and aliens. I would find out how many of the students believed in these things. By referring to various opinions and incidents I would try to show them that there is no scientific data to support a belief in UFOs and aliens and perhaps media hype and fantasy stories have distorted their opinions. This is another form of bias. The last activity would ask the students to select some of their favorite things and we would use symbols to translate this information into a likeness of a human face (graphical representation of data using Chernoff faces).

In order to determine the appropriateness of the topic and the timing of the presentation, I needed to practice the presentation in front of a student audience. As it was summertime, the neighborhood schools were on vacation. I had to use my own college-age children and their friends as my audience. After rehearsing my presentation for my children and their friends, it was apparent that this information is appropriate for any age group. However, you need to adjust the language so that it is suitable for the targeted audience.

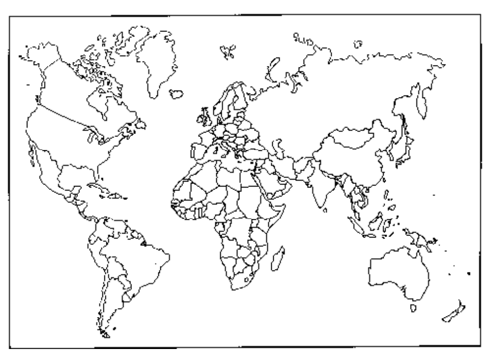
3. The Presentation

To start with, I let the students know how pleased I was just to have a chance to discuss ideas of statistics with them, an extremely useful subject and one I have been involved in for a long time. I let them know how impressed I was with their willingness to come to a new place and give their best attention to an unfamiliar subject. I promised them that I would try my best to make this experience both interesting and informative.

Fred Djang's "Our Planet Earth and Us" was a hit with middle schoolers.

4. Setting the stage

I explained to them that I chose the topic "Our Planet Earth and Us" because they already knew a lot about it and I was just there to bring out what they knew. To illustrate this point, I showed them a map of the world and asked them: "Where is the land? Where is the sea? Where do we live? Where is the (former) USSR? Where is China?" etc. This gave them a sense of confidence that they were able to understand the topic and helped make them comfortable, relaxed, and willing to participate.

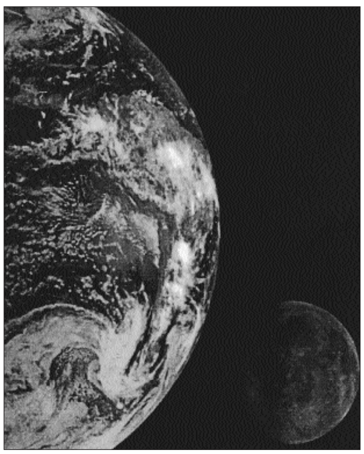


At this point, I told them a bit about myself and the school where I teach. With their classroom teacher's help, I gave them each a ball point pen with our school logo on it. They were to use the pens for the upcoming activities and could keep the pens as a reminder of the day. As we handed out the pens, some asked if any famous people had graduated from Choate. I named John Kennedy and they seemed to know who he was. I took the opportunity to mention the Kennedy Space Center as it would play a role in the first activity.

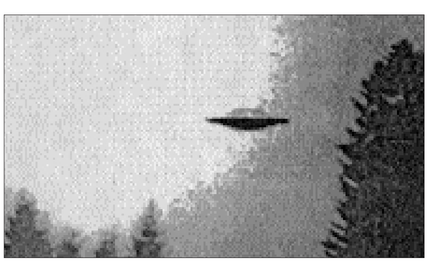
■ 5. Bias and estimation

A photograph of the earth and the moon was my second transparency. Everyone recognized the photo. The question I put to them this time was, "How is a photo like this taken?" The immediate response was that it was from a satellite, of course—like the ones sent up from the Kennedy Space Center.

I let them know that when I was their age no such photo existed since we were not able to get far enough away from the earth to take such a picture. I also said that if there were such things as UFOs and aliens, this might be what they would see as they approached the earth. When I asked how many of them believed in UFOs, to my amazement, every one of them responded in the affirmative. Throughout the rest of the presentation I wanted to point out to them that there was really very little concrete scientific evidence to indicate that UFOs exist. I suggested to them that their beliefs may have been influenced by television, movies, cartoons, and comic books. I showed them a well known, poorly focused photo which they identified as a UFO.

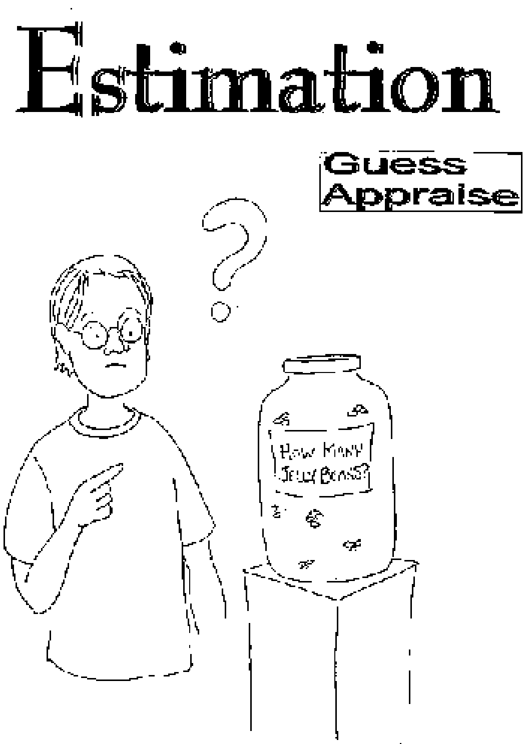


Transparency 2. The Earth and the Moon



This photo has been explained by some as a picture of a hubcap thrown into the air.

The next question I asked was, "If a UFO indeed approached the earth, would they wonder how much of the earth is land and how much is water?" "How might we estimate (guess) the proportion of land on earth?" Before proceeding to the activity to estimate the relative amounts of land and water on earth, I wanted to first talk about guessing. I took out a jar of candy and asked them to guess how many pieces were in the jar. I recorded their guesses and we noticed that the results varied a great deal and that probably none of them was exactly right. This is the essence of estimation. I told them that I would leave the candy for them after the presentation. This made them even friendlier toward me.



Transparency 4. Estimating the number of jelly beans in a jar. (Cartoon by Eric W. Mueller, Hopkins School, New Haven, CT)

Next I brought out three inflatable globes and told the students that we would use these to try to estimate how much land and water is on the earth. I gave the following directions and demonstrated at the same time. They were to take a globe in both hands, spin it, and catch it. Each was to note whether his or her right thumb was on land, water or both. I would record the frequency of the answers. They were to pass the balls, repeating the

Students estimate the percentage of land on earth.

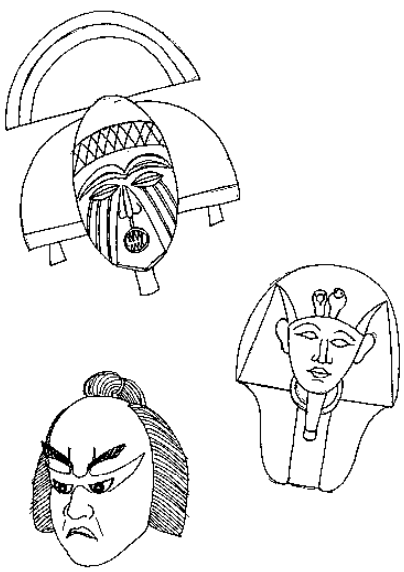
process until asked to stop.

In all classes, we came to the conclusion that there was more water than land, but the proportions were quite different from the actual measurements, approximately 30% land and 70% water (*New Standard Encyclopedia*, Volume 4, Chicago, Illinois, Standard Educational Corporation, 1968). From this, we conjectured that perhaps the land was made larger on the globes in order to have enough room to print the names of continents and countries—another example of bias. I suggested that they could continue to investigate this conjecture when they got back to their classrooms.

Table 1. Estimating the amount of land and water on Earth.

Class:	Land	Water	Both
Middle School (A)	24	25	8
Middle School (B)	10	22	6
Elementary School	12	25	0
Total	46	72	4

Transparency 5. Masks from Africa, Egypt, and Japan. (Drawings by Eric W. Mueller, Hopkins School, New Haven, CT)



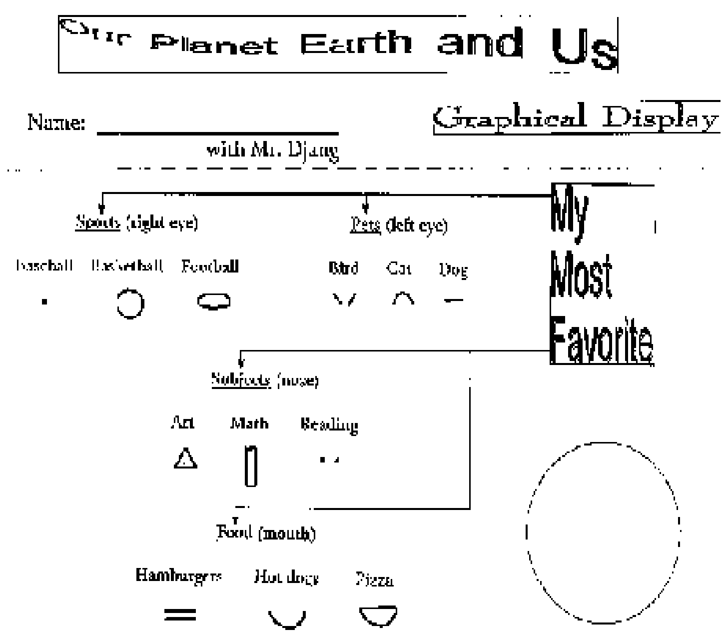
6. Graphical displays

Returning to the map of the earth, I pointed out that the contours of the continents support the theory that the continents all fit together at one time. Over millions of years they have drifted apart. It is a relatively recent event that transportation has made the world smaller and given the opportunity to get together again. One would think that we might celebrate this reunion, but instead it seems that people are often not very nice to each other. Many of us decide whether we like each other based heavily on how we look on the outside.

The next activity would demonstrate a statistical technique called graphical display (Chernoff faces) to see what the students inner selves might look like by using pictures to depict their favorite things. In preparation for this activity, I showed the students three masks, one each from Africa, Egypt, and Japan.

The students had no difficulty matching each mask with the correct region of the world. I explained that perhaps they were the depictions of inner selves from all parts of the world. After planting the seed for this idea, I handed out a

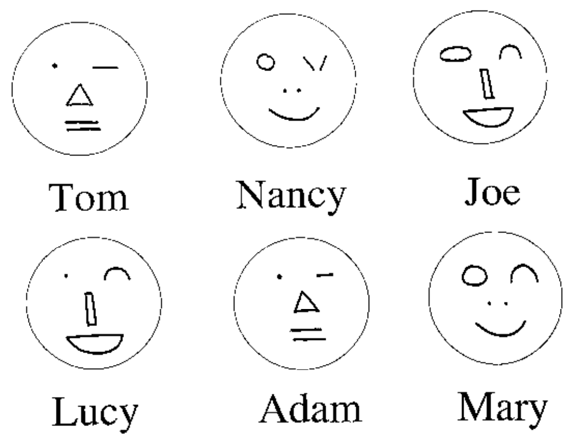
Worksheet 1. Representation of favorite sports, pets, subjects, and foods.



worksheet.

To get them to focus on the paper, I asked the students to fill in their names and check their choices of favorite sport, pet, school subject, and food. Some of the students said that the choices offered were not really their favorites or that they could not choose a favorite. I asked them to make the best choice they could and explained that since I did not know them and did not have a chance to get their input, I had offered things that I thought they might like. If they wanted to, they could try it again using things they really liked. I filled out a form using the overhead and used the selected figures on my worksheet to draw a face. I asked them to do the same using their choices. Before having the students look at each others' faces I showed them a set of six faces.

Transparency 6. Chernoff faces for six hypothetical students.



I asked the students to find the faces that were identical and they had no trouble doing that. Then I asked them to find those faces that had only one difference, and those which had nothing in common at all. While doing this we talked about the persons we want to have as friends. Some felt that they wanted friends who liked the same things they do. Others felt that they wanted their friends to like different things. I showed a cartoon of two people who look different on the outside but if they could see the other's inner faces, would discover that they are really very much alike.

I suggested that disliking people because of the way they look is a form of bias. If they take the time to get to know each other they may find that they have a lot in common. I handed out stickers and asked the students to draw their inner faces on the sticker and put them on their chests. I then asked them to walk around the room to see who looked like them on the inside. The second graders especially enjoyed this and they would come to show me what they had discovered. One group of three was particularly excited about the fact that

Transparency 7. Illustration of bias. (Cartoon by Eric W. Mueller, Hopkins School, New Haven, CT)

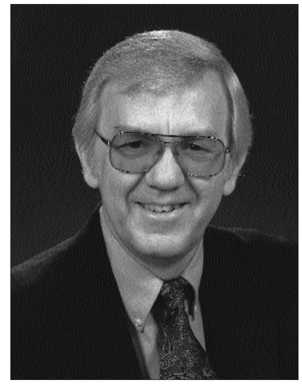
they were identical on the inside.

7. Reflections

Reflecting on the day, I concluded that doing three sessions in half a day is exhausting. It was very good to have the classroom teachers there. They acted as liaisons between the presenter and the students and had a good sense of what needed to be done. It also showed the students that this was a cooperative effort and their teachers were part of it. All three classes were attentive and eager to participate throughout the presentation. When I thanked them for being such a good audience and participating so well, much to my amazement, each class applauded and expressed appreciation for the experience.

I enjoyed doing this presentation. Public Statistics Day gives our youngsters an understanding of the usefulness of statistics. It can have an impact on their future course decisions and perhaps their career choices. This year the Advanced Placement Statistics examination was offered to high school students for the first time. Youngsters can certainly be introduced to statistics much earlier than high school. This is reflected in the curriculum change outlined by the National Council of Teachers of Mathematics (NCTM) recommended standards. We need to have more statisticians participating in events that promote the idea of statistics to K-12 students. I understand that many statisticians are reluctant to get involved with something like a Public Statistics Day because they don't usually work with students in these age groups. Perhaps

Making the Grade—AP Statistics, 1997



Richard L. Scheaffer

■ 1. Background and Overview

During the second week of June, 1997, 56 statistics teachers, about half from colleges and half from high schools, descended on the quiet campus of the College of New Jersey to "read" AP Statistics Exams. It was an experience of significant effect on their lives, the future of statistical education in the United States, and possibly even the campus descended upon. For the readers it was a professional experience that broadened and deepened their outlook on statistics, in terms of both pedagogy and content. *For statistical education it was the culmination of a long effort to be seen as a viable and vital component of the high school curriculum*. For the College of New Jersey it was another opportunity to show off its fine facilities and excellent food, an opportunity not overlooked by any of the readers.

The story of Advanced Placement Statistics began about 20 years earlier when the AP Calculus Committee started to look for ways to expand AP offerings in the mathematical sciences. Recommendations to consider a statistics exam surfaced as early as 1980, but were not acted upon because the interest did not seem strong, and the questions about what the course would cover and who would take it seemed more numerous than the answers. Follow-up surveys of both high schools and colleges in 1987 and 1992 showed increasing interest in the subject and increasing agreement as to the content areas that should be covered in an introductory statistics course. With this mounting evidence that an AP statistics course would be well received and successful, the College Board approved the formation of an AP Statistics Development Committee, which began work in 1994.

This was the first exam ever offered in statistics. Therefore, the Development Committee and the Chief Faculty Consultant had some apprehension as to how many students would actually take it and how it would be perceived in terms of content and difficulty. All were amazed to find that approximately 7600 high school students sat for the exam, and were relieved to see that enough readers could be secured to score the exam efficiently. The Committee succeeded in developing a course that has won wide acceptance by both teachers and students, which is why the 56 readers assembled in June had such a rewarding experience.

■ 2. Content and Structure of the Exam

As outlined in the *Course Description*, the AP Statistics course is to emphasize four main areas:

- Exploring Data: Observing patterns and departures from patterns
- Planning a Study: Deciding what and how to measure
- Anticipating Patterns: Producing models using probability and simulation
- Statistical Inference: Confirming models

The exam contained questions from all four areas in both the objective (multiple choice) and free response parts, with the section on Planning a Study having fewer objective questions than the others. The multiple choice questions used on the 1997 exam will not be released until after the 1998 exam. The complete *Course Description* can be obtained from the College Board. The objective portion of the exam, containing 35 questions, counted for one half of the total score. The free-response portion contained five short-answer questions and one investigative task (25% of free-response score) requiring a longer answer. A copy of the short-answer questions is provided on page 9.

As a professor of statistics at the University of Florida for over 30 years, Richard Scheaffer has been invoved with many statistics education projects covering K-12 curricula as well as undergraduate and graduate programs. A Fellow of the ASA, he chaired the task force on the feasibility of AP Statistics and is now the Chief Faculty Consultant for that program.

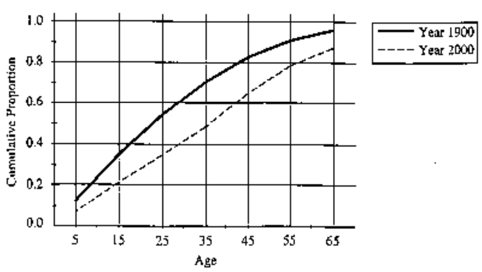
STATISTICS SECTION II Part A

Questions 1-5: Spend about 65 minutes on this part of the exam. Percent of Section II grade—75
Show all your work. Indicate clearly the methods you use, because you will be graded on the correctness of your methods as well as on the accuracy of your results and explanation.

AGE DATA

Age	1900	2000
5	0.121	0.066
15	0.344	0.209
25	0.540	0.344
35	0.700	0.480
45	0.822	0.643
55	0.906	0.781
65	0.959	0.870

1. The table of data above provides the cumulative proportions for the United States population at selected ages for the years 1900 and 2000 (projected). For example, 0.344 or 34.4 percent of the population was at or under age 15 in 1900, while only 0.209 or 20.9 percent will be at or under age 15 in the year 2000. The graph below shows the cumulative proportions plotted against age for the years 1900 and 2000 (projected). The data and graph are to be used to compare the age distribution for the year 1900 with the projected age distribution for



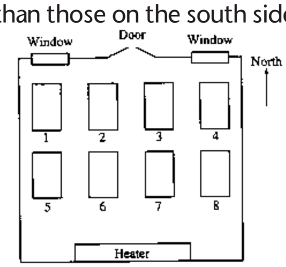
the year 2000.

(a) Approximate the median age for each distribution.

(b) Approximate the interquartile range for each distribution.

(c) Using the results from parts (a) and (b), write a sentence or two for a history textbook comparing the age distributions for the years 1900 to 2000.

2. A new type of fish food has become available for salmon raised on fish farms. Your task is to design an experiment to compare the weight gain of salmon raised over a six-month period on the new and the old types of food. The salmon you will use for this experiment have already been randomly placed in eight large tanks in a room that has a considerable temperature gradient. Specifically, tanks on the north side of the room tend to be much colder than those on the south side. The



arrangement of tanks is shown on the diagram below. Describe a design for this experiment that takes account of the temperature gradient.

3. A laboratory test for the detection of a certain disease gives a positive result 5 percent of the time for people who do not have the disease. The text gives a negative result 0.3 percent of the time for people who have the disease. Large-scale studies have shown that the disease occurs in about 2 percent of the population.

(a) What is the probability that a person selected at random would test positive for this disease? Show your work.

(b) What is the probability that a person selected at random who tests positive for the disease does not have the disease? Show your work.

4. A random sample of 415 potential voters was interviewed 3 weeks before the start of a state-wide campaign for governor; 223 of the 415 said they favored the new candidate over the incumbent. However, the new candidate made several unfortunate remarks one week before the election. Subsequently, a new random sample of 630 potential voters showed that 317 voters favored the new candidate.

Do these data support the conclusion that there was a decrease in voter support for the new candidate after the unfortunate remarks were made? Give appropriate statistical evidence to support your answer.

5. A company bakes computer chips in two ovens, oven A and oven B. The chips are randomly assigned to an oven

Percentage of Defective Chips

Hour	Oven A	Oven B
1	45	36
2	32	37
3	34	33
4	31	34
5	35	33
6	37	32
7	31	33
8	30	30
9	27	24

and hundreds of chips are baked each hour. The percentage of defective chips coming from these ovens for each hour of production throughout a day is shown below.
The percentage of defective chips produced each hour by oven A has a mean of 33.56 and a standard deviation of 5.20. The percentage of defective chips produced each hour by oven B has a mean of 32.44 and a standard deviation of 3.78. The hourly differences in percentages for oven A minus oven B have a mean of 1.11 and a standard deviation of 4.28.

Does there appear to be a difference between oven A and oven B with respect to the mean percentages of defective chips produced? Give appropriate statistical evidence to support your answer.

■ 3. Grading the Free-Response Questions

Answers to the free-response questions were graded according to holistic rubrics on a five-point scale that were refined by the leadership team during the two days prior to the reading. For each question, students were expected to:

- demonstrate knowledge of the statistical concepts involved,
- communicate a clear explanation of what was done in the analysis and why,
- express a clear statement of the conclusions drawn.

Readers were briefed on the rubrics and practiced on sample copies of student responses before grading the papers. The leadership team was satisfied that this method allowed for consistent scoring of open-ended questions for which many different approaches could be equally correct and for which a written statement on assumptions and conclusions was required. Selected student answers to the free-response questions along with copies of the rubrics and comments on strengths and weaknesses of the student responses are published in *AP Statistics Free-Response Questions 1997*, which can be obtained from the College Board.

Comments from readers during the debriefing meetings suggest that they were happy with holistic grading for open-ended questions of this type, although some of the rubrics used could have been more refined and training periods longer. Readers were virtually unanimous in wanting to try this system again next year. Suggestions were given on ways to improve questions for consistent application of holistic grading.

Other comments from the readers provided ideas on how to better align the questions asked with the content outline presented in the *Course Description* (by moderate changes to one or the other). Constructing questions that deal with conceptual understanding yet allow graphing calculator use is a challenge that received considerable discussion. The allocation of the exam time for short-answer questions versus the investigative task seemed to be fair, according to the readers, but consideration should be given to reducing the number of the former.

The six free-response questions covered the areas of data exploration, study design, probability, statistical inference and fitting models to data. The data exploration question (Question 1) involved cumulative proportions, which is not adequately covered in most standard textbooks, but was based on relatively simple data sets and asked for summary statistics and interpretations well within the content outline for this course. The design question (Question 2) asked students to explain how they would set up an experiment, and a complete response required explanation of both blocking and randomization. The probability question (Question 3) required some knowledge of conditional probability, but the answers could be found through logical thinking, without appeal to formal theorems on probability. The two inference questions (Questions 4 and 5) required the comparison of two proportions and the analysis of the mean of paired differences, respectively. These questions were typical of those found in textbooks and, hence, generated extensive responses from many students, although the mean scores were not significantly better than those on other questions. The investigative task (Question 6) required the student to critique models already fit to a set of data and then to find a model that did not have the weaknesses of those presented. For this question, students possessing skill with a graphing calculator could have an advantage, but this was partially offset by a grading scheme that gave as much weight to good explanation as to clever calculation.

■ 4. Scores and Grade Setting

Table 1 shows summary statistics for the cumulative scores (out of 100) and the breakdown for the objective and free-response portions of the exam (each out of 50). Figures 1 and 2 show the cumulative frequency distributions for the composite scores, the objective scores and the free-response scores. *On the whole, students performed much better on the multiple choice questions than on the free response questions*. The Committee began writing these questions over three years ago and finalized the questions for this exam over a year ago. Much experimentation was taking place in the early days of test development as Committee members grappled with the issue of how to write substantive multiple choice questions on statistical concepts, as opposed to straightforward questions involving calculations. Much has been learned in the process, and it is anticipated that a higher percentage of the multiple choice questions on future exams may deal with the understanding of concepts.

Table 1. Summary Statistics on Composite Scores for AP Statistics.

	Composite	Objective	Free Response
Median	47	31	15
Mean	46.8	30.4	16.5
Standard Deviation	18.9	10.4	9.6

Table 2. Grades, Boundary Scores, and Percentages for AP Statistics.

Grade	5	4	3	2	1
Minimum Score*	68	54	41	29	0
Percentage of Students	15.7	22.1	24.4	19.7	18.0

** Lowest composite score to qualify for that grade, out of 100 total points*

Table 2 shows the grade boundaries on the composite scores for each of the final AP grades, along with the percentages of students obtaining these grades. These boundaries were determined after careful consideration of the distributions of objective, free-response, and composite scores, and after relating these scores to scores of college students obtained on a comparability study (to be explained below).

For comparison purposes, Table 3 shows the grade distributions for the 1997 AP Calculus AB, Biology, Chemistry, and Physics B exams. Distributions of composite scores for these subjects do not differ greatly from those seen in AP Statistics. Although one would always like students to achieve higher composite scores, the statistics grades appear to be in line with grades from mathematics and the sciences.

In summary, the examination contained a fairly easy multiple choice section and a challenging free-response section. The questions in the latter appear to be fair, in light of the course description, but many students were not adequately prepared to explain and defend methods used and to write clear conclusions reflecting both good statistics and good writing. This subject will be addressed further in a later section.

■ 5. Comparability Study

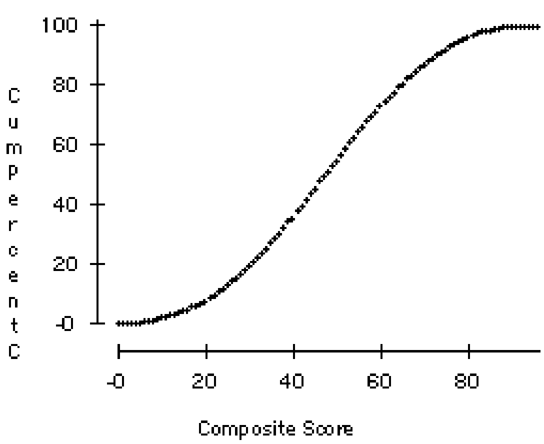
Table 3. Grades Distributions for AP Calculus AB, Biology, Chemistry, and Physics B, 1997.

Grade	5	4	3	2	1
Calculus AB Percentages	11.9	20.4	27.3	19.9	20.5
Biology Percentages	18.7	21.8	23.4	21.9	14.2
Chemistry Percentages	16.0	14.5	27.9	22.5	19.0
Physics B Percentages	12.1	16.5	32.0	16.0	23.4

For the comparability study, a sample of colleges and universities from around the country agreed to have students in their introductory statistics courses (courses covering material similar to that on the AP Statistics outline) complete some of the questions from the AP exam as part of the assessment process in those courses. Over 1000 students from 15 colleges and universities participated in this study.

Student scores on the sample AP questions as well as each student's final grade in the course were reported to ETS. AP exam composite scores were estimated for each of the participating college students by a procedure known as equal percentile ranking. First, the rubric-based score was computed for each college student based on that student's performance on the AP questions he or she saw. Second, the distribution of scores for the AP candidates based on those same questions was produced. Third, the percentile rank of each college student's score in the distribution of the scores for the AP candidates was found. Finally, the corresponding AP composite score for each college student's percentile rank was determined based on the distribution of composite scores for the AP candidates.

Grade boundaries can then be related to the



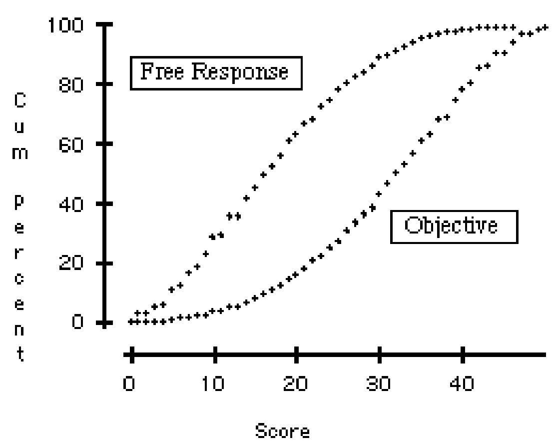


Table 4. Mean Composite Score by AP Grade or College Grade.

AP Candidates		College Students	
AP Grade	Composite	Final Course	Composite
5	75.7	A	51.8
4	60.1	B	40.6
3	47.0	C	31.4
2	34.8	D	26.4
1	19.0	F	17.7

grades the college students actually received in the course. The boundary between five and four was higher than the average composite scores of students receiving As in the courses given at these schools. Thus, one can think of this boundary as being around the average score of the students receiving A+s in these courses. The boundary between four and three was higher than the average scores of the A students in nearly half of the colleges, and higher than the average scores of the B students in all colleges. In other words, this boundary is around the average of the A or low A students. The boundary between three and two is higher than the average scores of the B students in nearly half of the colleges, and higher than the averages for students receiving Cs at all colleges. Table 4 shows the mean composite scores for the AP candidates and college students in the comparability study grouped according to their AP grade or college class grade. The correlations between the instructor-assigned grades and the AP composite scores for the college students range from .40 to .98 with a median of .83.

It is not surprising that the AP candidates had higher scores, in general, than their college counterparts. The AP students are highly motivated, for the most part, and had just completed a two-semester course around which the exam was designed. For the college students, the few AP questions they saw were just one part of many tests that contributed to their final grade in the course—usually a one-semester course for which they may not have been highly motivated and for which the AP syllabus is not the main guide. Nevertheless, AP candidates receiving a grade of four or five seem to perform at or above the level displayed by most college students receiving a grade of A in their introductory statistics course.

6. Student Preparation

Even if the top AP candidates perform favorably as compared to a sample of college students, the distribution of scores on the free-response portion of the exam were quite low and uniformly so over all areas tested. These questions intentionally gave little direction as to how the student was to approach the problem and the rubrics gave credit for any correct method. However, for inference problems the rubrics required students to explain the method used along with the assumptions for the method, and to look carefully at the data to see if they thought the assumptions were satisfied. The analysis must be followed by a clearly stated correct conclusion, written in the context of the original question. Many students had difficulty determining what method to use, often trying two or three approaches or mixing approaches in ways that were unclear to the reader. In addition, students had difficulty explaining assumptions and rarely looked at the data or considered the context of the problem to see if the assumptions were reasonable. Conclusions were often poorly written in terms of both statistical concepts and grammar. In summary, students must learn to view statistical inference as a process that involves understanding the problem to be solved, finding an appropriate method, checking the assumptions for the method against all the available information, carrying out the analysis, and writing a clear and correct conclusion in the context of the original problem.

For the question on the design of an experiment, many students appeared to be confused about what constituted the treatments and what constituted the experimental units. Among those who seemed to grasp this idea, many did not understand that blocking is the best way to reduce variation among the experimental units or got confused about how to block appropriately. In addition, many did not understand that randomization is necessary to reduce bias and to allow probability-based methods of analysis to be used after the data are collected. In short, the preparation of students on the basic principles of blocking and randomization for designed studies was quite weak.

7. Conclusion

The first year of the AP Statistics program must be considered a success based on the number of students taking the course and exam, the interest of many teachers in high schools around the country, and the enthusiasm of the readers who assembled to score the first exam. There is room for improvement, and the Test Development Committee is already considering changes designed to resolve issues that arose during this introductory year. It appears, however, that AP Statistics has made the grade and will remain a solid member of the AP family.

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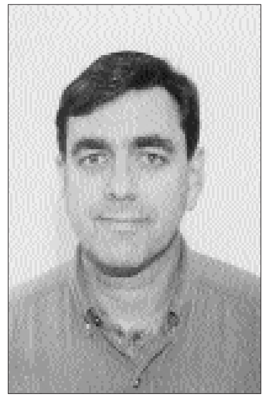
Advanced Placement Course Description: Statistics, The College Board, New York, 1997.

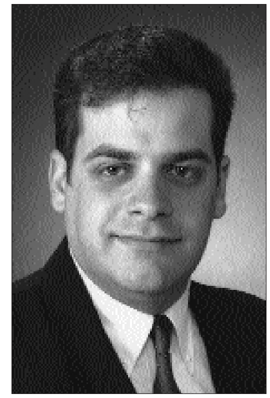
AP Statistics Free-Response Questions, The College Board, New York, 1997.

Teacher's Guide: AP Statistics, The College Board, New York, 1997.

Iowa Roars to the 1997 College Bowl Crown



Don Edwards

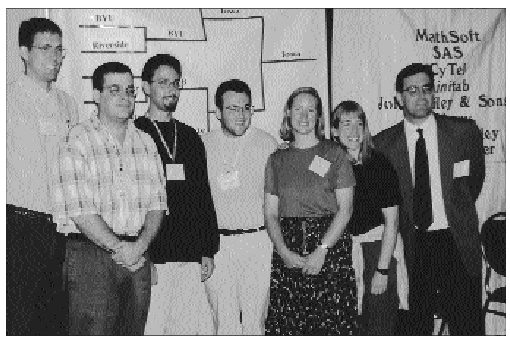


Mark Payton

■ 1. Hawkeyes Blitz Field in Anaheim

The 1997 College Bowl at the Anaheim Joint Statistical Meetings, sponsored by Mu Sigma Rho, the National Statistical Honor Society and the ASA Section on Statistical Education, was once again a big success. Teams representing seven graduate programs (and three Mu Sigma Rho chapters, denoted by asterisks) competed: Baylor, Brigham Young (BYU)*, Iowa, Iowa State*, Nebraska*, University of California-Santa Barbara (UCSB), and University of California-Riverside (UCR). The competition was organized by 1997 Mu Sigma Rho President Don Edwards of South Carolina and President-elect Mark Payton of Oklahoma State.

After Tuesday morning's preliminary competition, emceed by George Casella of Cornell, teams from BYU, Iowa, Iowa State and UCSB advanced to Wednesday's second round, emceed by Linda Young of Nebraska. Wednesday's semifinal round between defending champion Iowa State and newcomer UCSB was one of the closest ever–only five points separated the two teams going into the final question (worth 10 points), which began: "True or False...." UCSB answered it correctly, and advanced to the finals. Iowa won the other semifinal match handily over BYU, which won honorable mention for Most Improved and Best Dressed Team (by virtue of their spiffy College Bowl t-shirts).



(L to R): Iowa alternate Jeff Isaacson; College Bowl co-organizer Mark Payton; Iowa regular team members John Castelloe, Christopher Carolan, Michelle Larson, and Joy Jordan; co-organizer Don Edwards.

In the finals, Iowa again rolled over UCSB (which won the award for Best Newcomer). Throughout the entire competition, Iowa put on an amazing display of correct answers buzzed in mid-question. Obviously, the Hawkeyes had come prepared, and it paid off! As accomplished contest winners, Jeff Isaacson, Chris Carolan, and Michelle Larson also placed first, second, and third, respectively, in the 1997 *STATS* football poll (see *STATS* 18, 1997, p.28).

Don Edwards is a professor and director of graduate studies in the Department of Statistics, University of South Carolina, Columbia. he is past-President of Mu Sigma Rho. Mark Payton is an associate professor in the Statistics Department at Oklahoma State University and is currently serving as National President of Mu Sigma Rho.

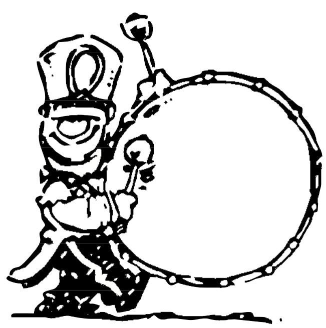
TABLE 1. A Brief History of the College Bowl

Date	Place	Results	Teams	Moderators	Organizer
January 1992	ASA Winter Conference Louisville, KY	Bowling Green def Virginia Tech	Four	Bob Stephenson (Iowa State)	Bob Stephenson (Iowa State)
January 1994	ASA Winter Conference, Atlanta, GA	Iowa State def Florida	Eight	Stuart Hunter (Princeton)	Ralph St. John (Bowling Green) Linda Young (Nebraska)
January 1995	ASA Winter Conference Raleigh, NC	Nebraska 2 def Bowling Green	Eight	Mitchell Gail (National Cancer Inst.)	Ralph St. John (Bowling Green) Linda Young (Nebraska)
August 1996	Joint Statistical Meetings, Chicago, IL	Iowa State def Chicago	Eight	Bob Hogg (Iowa) Mark Payton (Oklahoma St.)	Don Edwards (South Carolina) Mark Payton (Oklahoma St.)
August 1997	Joint Statistical Meetings, Anaheim, CA	Iowa def UC-Santa Barbara	Seven	Linda Young (Nebraska) George Casella (Cornell)	Don Edwards (South Carolina) Mark Payton (Oklahoma St.)

■ 2. Why Play College Bowl?

Besides the fun of participating and the knowledge and useful information learned, every student participant in every College Bowl has received an award. The 1997 College Bowl, as in years past, saw excellent corporate sponsorship, with very generous awards offered by MathSoft, SAS, Minitab, StatXact, Marcel Dekker, John Wiley & Sons, Addison-Wesley, and Duxbury, with a total dollar value exceeding $10,000! Awards ranged from student versions of popular statistics software, to textbooks, to several full professional versions of statistical software. Award selection was by “playground rules:” the members of the winning team (in random order, of course) chose first, from all the award vouchers. Next, the second-place team chose from remaining vouchers, and so on.

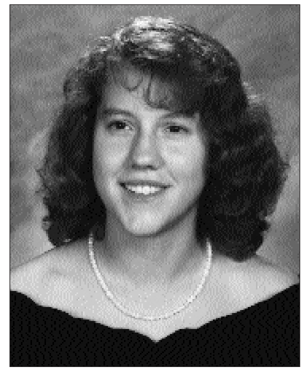
■ 3. Let's Get Ready for Dallas!



The College Bowl is scheduled to return in 1998 at Dallas, organized by Mark Payton of Oklahoma State and Jim Albert of Bowling Green. On tap to serve as moderators are Wayne Woodward of Southern Methodist (adding some local flavor) and long-time college bowl friend John Boyer of Kansas State. It is anticipated that several of the '97 sponsors will return as sponsors in '98, and there will surely again be awards for the top eight teams. Teams consist of 4 players (no alternate). Players must have been a student in good standing (at any level) at some time during the 1998 calendar year. Joint teams from multiple universities/colleges are welcome. Rules of play and sample questions can be found at *http://www.stat.sc.edu/msrnatl.html*.

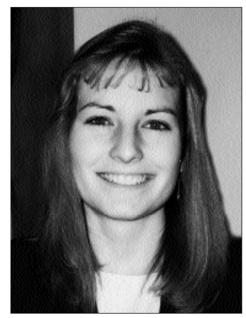
To reserve a spot for your team, there are no registration fees or forms to fill out. All we ask is that you (1) reserve your spot in good faith (i.e., make a commitment to actually field a team), and (2) write at least 10 questions for competition. Please feel free to submit as many questions as you want. All questions submitted by your team are distributed evenly among all the games to assure fairness for all teams. If you expect to field a team, please notify Mark Payton as soon as possible at *mpayton@okway.okstate.edu*.

Your team is not officially registered, though, until it submits its questions. Deadline for registration (question submission) is July 1, 1998. “Byes” for the first round will be awarded first to early registrants.



Amy J. Heffelfinger

Brenda R. Horst Phillips



Experience Can't Be Beat

School is about learning. However, it is also about preparing for a future in the professional community. Bridging the gap between academic endeavors and a career in the “real world” is a challenge facing almost all college seniors, especially during the final months preceding graduation. For us, the key to the transition was our internship experiences.

We all attended Messiah College, located in

Brenda R. Horst Phillips is currently a senior statistical analyst in the Department of Health Evaluation Sciences at Penn State's College of Medicine in Hershey, Pennsylvania. She plans to pursue a graduate degree in Biostatistics. Melanie B. Wigg is now a student at the University of Waterloo in Waterloo, Ontario. She is pursuing a Master's degree in Statistics. Amy Heffelfinger is currently studying Biostatistics at the University of North Carolina in Chapel Hill. She is especiallly interested in using her knowledge of statistics in the field of Genetics.

Grantham, Pennsylvania, and majored in Mathematics with a Statistics minor. Each of us in our senior year of college, 1995–96, had the opportunity to gain invaluable, practical experience in our field of study through working as statistical analyst interns in the Center for Biostatistics and Epidemiology (CBE) at Penn State's College of Medicine in Hershey, Pennsylvania.

CBE was created in 1987 in an attempt to meet the College of Medicine's increasing need for biostatistical and epidemiological resources. Its growth has been tremendous. At the time of our internships (1996), CBE housed over 40 full-time employees at various educational levels — quite a jump from the four employees of 1988. In 1992 the structure of CBE was expanded to encompass three separate units: biostatistics, epidemiology, and health services research.

How did statistical analyst interns fit into this picture? Most of our work involved designing and using computerized data entry systems, preparing data sets for statistical analysis, and performing statistical analyses as directed by statisticians. We were also involved in the preparation of reports for investigators (usually physicians) or hospital administrators. That involvement may have included anything from creating tables and graphs to contributing our own creative ideas about the format of a report.

Such experience was not only valuable for the development of skills but also for the exposure to numerous facets of biomedical research, an experience that cannot be replicated in the classroom. First of all, we encountered the variety of statistical analyses and procedures being implemented in current medical studies. Before we began the analysis programming for a particular study, our supervisors carefully explained the nature of the data and how the proposed analysis would accurately answer the question under investigation. Though some procedures were familiar to us through our classroom studies, many were beyond the scope of our college courses, such as survival analysis, repeated measures, and testing for equivalence. Encountering previously studied techniques reinforced our classroom experience; exposure to new ones prepared us for further graduate study.

Secondly, we were given a glimpse into the medical field. We were exposed to cutting edge biomedical research investigating diseases such as asthma, interstitial cystitis, and sleep apnea. Other studies explored bone density in young women, computer tomography techniques, methods of cholesterol control, and the bioequivalence of drugs. In addition, we became familiar with the components of running clinical trials, such as protocol structure, randomization, the use of placebos, drug assignments, and sample size calculations.

Furthermore, we were given the opportunity to enhance our computer programming skills and experience, and to absorb knowledge of various computer systems. Each of us worked at an individual workstation equipped with a UNIX Sun SPARCstation using a Solaris OpenWindows Version 3.4 operating system. Through our daily tasks and exploration of the system, we increased our knowledge and skill in moving about the system and finding ways to perform tasks more quickly and elegantly. Many of these skills were logic skills that were transferable to any system, while others were unique to a given software package. Each experience with a new system or software package made learning the next one easier.

By far, most of the work that we did involved programming in SAS, a leading statistical software package, but collectively we also used other packages such as S-Plus, StatXact, and MINITAB. Framemaker, WordPerfect, Excel, and DBMS/COPY were commonly used as well.

Lastly, we learned the important techniques involved in report writing. There is an art to reducing a great amount of detailed information into an understandable, informative report. The ratio of information to ink must be as great as possible so that busy administrators and physicians can find the information they need as quickly as possible. This may involve tables, bar graphs, plots, or summary statistics. Creativity can be helpful in trying to accomplish the task of making the report aesthetically pleasing as well as informative.

One of the studies that Amy worked on was part of the Penn State's Young Women's Health Study. The study is a randomized, double-blind, placebo-controlled trial that investigates the effect of calcium supplementation on bone acquisition in white adolescent girls. At the outset 12-year-old girls were randomly selected to receive either calcium supplementation or placebos. During the first two years, it was determined that the calcium supplementation group had significantly greater rates of all bone acquisition measurements than did the placebo control group. In order to study the effect of initiating calcium supplementation at age 14, the girls were re-randomized after two years such that half of the original supplementation group continued supplementation while the other half began taking placebos. Likewise, half of the original placebo group continued taking placebos, while the other half began supplementation. The group that switched from placebos to calcium supplementation had the greatest annualized gain in all bone outcome measurements. The data indicated that calcium supplementation benefits bone mass gain in adolescent girls and that the supplementation can be initiated at age 12 or 14.

Programming in SAS, Amy created frequency tables and computed descriptive statistics, such as means, standard deviations, and correlation coefficients, in order to compare and contrast the four study groups. She also performed *t*-tests and ANOVA procedures to determine factors that may help or hinder bone acquisition, such as nutrition, exercise, height, and weight. She performed these and a variety of other types of statistical analyses under the guidance of her supervisor. Additionally, she used S-plus and WordPerfect to create charts, tables, and graphs to display data and results for the study's publications and presentations.

Melanie focused primarily on one specific investigation entitled CARDES (CARdiovascular Dietary Education System). This study analyzed the effectiveness of a certain dietary education program in a low literacy, minority population in Washington, D.C. The 339 participants in this investigation were randomized into two groups: instructional and self-help. The instructional group followed the dietary program under investigation, which included attending nutrition classes and listening to prepared audio tapes. In addition, written dietary information was given to all participants. These participants were checked every four months over a span of one year. At these visits fasting blood work and overnight urine samples were taken for laboratory analysis, and dietary information was recorded. It was hypothesized that a greater overall lowering of blood serum cholesterol would be observed in the instructional participants due to dietary changes throughout the study.

Melanie was involved in several areas of the CARDES investigation. She was largely responsible for maintaining accurate SAS data sets of laboratory results through SAS programming. This included concatenating incoming monthly results with previous data and checking for possible errors. She also wrote code for analyses of baseline data using general linear models and logistic regression and generated frequency tables for descriptive purposes. These results were then compiled into tables for use in upcoming publications. In addition, she met specific programming requests on an ongoing basis, providing her with a wide range of interesting challenges.

One of Brenda's main projects involved reporting inpatient satisfaction survey results. Hospitals, like any other business, want to ensure that people choose their facilities over those of their competitors. Patient satisfaction surveys help to identify areas in need of improvement.

Not every patient was asked to complete the survey, so a group of representative patients was sampled to receive it. Monthly data were sent to a survey firm that administered the survey and returned the response data. Brenda verified that the data were free of inconsistencies. Since not all sampled patients responded, age and gender information were used to weight the responses. This procedure adjusted for nonresponse, making the data more representative of the entire population of patients.

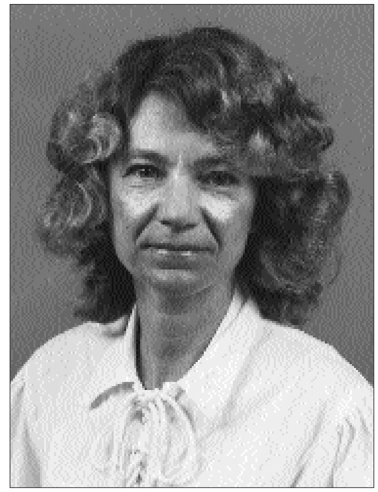
Frequency tables, Cochran-Mantel-Haenszel statistics, and *p*-values were produced to indicate whether responses of patients from one service (e.g., Surgery, Medicine, Pediatrics) differed significantly from those of other services. Brenda also performed a regression analysis using forward variable selection to identify those questions that were associated with how well the patients' expectations were met. She and her team assembled these items into a concise report. Ideally, administrators, physicians, and nurse managers who receive the reports work together to improve the hospital in any areas of weakness.

Focusing on extensive projects such as these exposed us to some of the complicated ethical issues that statisticians face. Missing data are inevitable and it is not always clear how the actual data should be analyzed. If the reliability of data is in question, one must also determine the proper course of action. Other difficult decisions involve motivating study participants without coercion and measuring compliance. Exposure to such statistical and ethical issues gave us a more realistic picture of clinical research.

The internship experience at CBE has proven invaluable to all who have participated, for us as well as for the interns before us. Melanie has gone on to study statistics at the University of Waterloo, and Amy is pursuing biostatistics at the University of North Carolina. Brenda is currently the senior statistical analyst in the Department of Health Evaluation Sciences (CBE became the Department of Health Evaluation Sciences in 1997) and intends to attend graduate school for biostatistics in the near future.

On the Job

A Day in the Life of a Statistician at Los Alamos National Laboratory



Jane Booker

JANE BOOKER, PH.D.
Group Leader
Statistics Group
Los Alamos National Laboratory

Just call me Jane. In a community with the nation's highest per capita of Ph.D.s, no one uses titles. My day begins while it is still dark outside. As usual, I am in my office with computers booted—all set for another day at the Statistics Group at Los Alamos National Laboratory. This pre-dawn starting time is my choice for we have the flexibility and academic freedom to work according to our personal optima. While I enjoy getting an early start, others prefer to come in late and stay late. I also enjoy the scientific/engineering environment at one of the world's most respected research and development institutions. As the Group Leader of this organization, I spend about half my time on *real* work. So for this diary of my day, I will omit the half of my day that concerns the administrative and management duties.

Los Alamos National Laboratory is part of the University of California system, not the U.S. government. Located in the northern New Mexico mountains at 7400 feet, it is the perfect place for the statistician who is a scientist at heart and wants to be part of various projects and programs here. These include human genetics, nuclear weapons, exotic materials, particle physics, instrumentation, accelerator technology, intelligence, defense, computation, simulation, and environmental science. Our statisticians work in these and more application areas, usually as members of multidisciplinary teams, learning and applying diverse statistical methods. We tend to work on more than one project at a time, with durations ranging from a few days (walk-in) to several years. We statisticians are located together organizationally and physically in the same hallway in the main Technical Area of the Laboratory. We help each other and collaborate, even if we are not officially assigned to the same projects.

Our customers, who fund our work, come from other government agencies (e.g., Nuclear Regulatory Commission, Department of Transportation, Department of Defense), within the Laboratory, and from industry. The work for national defense is a huge portion of the Laboratory's budget and mission, and, is therefore a significant portion of our work as well. This work requires strict controls on computing, documents, and information handling in a classified environment. As a result, our offices are in a secure area, and there are days when the camouflaged guards patrol our hallway. (Some good advice is to say hello to these guys especially when they are packing their armaments.) However, our work with industry is just as clandestine and exciting. Often our industrial customers do not even want it known, to the outside world, that we collaborate with them.

As a result of changing project needs and application areas, we have to be constantly learning new statistical methods. Currently, I am learning empirical Bayes methods for a reliability project with an industrial customer (one of the *Fortune* 500 companies, who will remain nameless) and fuzzy control systems (sometimes called rule-based systems) with weapons engineers for a project in predicting the performance of nuclear weapons systems in the stockpile. Data fusion (called data pooling because *fusion* has a very special meaning here) is another area of interest in both these projects where data is sparse or non-existent and yet modeling and predictions under uncertainty are required for making decisions and planning for the future.

By 6:00 A.M., my Power Mac and SPARC workstations are up and running, and I am checking my E-mail. A few minutes later the phone rings; it is one of our East coast customers. Today the technical project leader has called to say he has sent out the final draft of our paper for an upcoming conference on quality and integrity. We often co-author with our customers in their journals and for their conferences. The subject of the paper is our methodology for reliability characterization in a product/process design assurance program. The methodology is still under development, so the customer and I spend about another hour going over a technical issue. We need to determine how to best interpret input from the design engineers for formulating prior distributions into a reliability block diagram. We also need to determine how such distributions affect results depending upon whether they are applied at the failure mode or component levels in the diagram. Often data enters into a hierarchical logic diagram at higher levels than the basic event level, and it may be only partially applicable to those items in the higher levels. This poses interesting problems when distributions coming in at these levels must be combined with those propagated up from the lower levels.

Our statisticians work … as members of multidisciplinary teams …

By now, the others in the group are coming into work, and one or two of my colleagues who work with me on projects will bop in my office. Today, I need to brief one of them on the conversation I just had with our customer, and together we plan how this affects our methodology development and ultimately automation of the method using MATLAB statistical software.

On Fridays at 9:00 A.M. our group goes for a traditional coffee break over at the cafeteria (which is one of the best places to eat in our small town). The conversation is not technical, and usually we talk about matters important to life. This Friday, it was about how to get rid of the gophers ruining our yards and how bad the coyotes have been this fall.

The remainder of the morning is dedicated to addressing the new things emerging from the Laboratory inter-office mail, regular mail, the fax machine, E-mail, other phone calls, voice mail, visits, and trying to make some progress on encoding prior distributions into MATLAB, which I just loaded on my Mac and am trying to learn. Today, an E-mail came from an engineer interested in dose-response modeling in an application area of sensor work, asking for some walk-in help. Whenever someone says, “I've just got a quick (or simple) question for you,” it usually ends up as neither quick nor simple. So by the time I meet with this engineer and show him my initial interpretation of what he says he wants, there will probably be more to do. But that is the nature of consulting.

By 11:00 A.M., it is lunch time for the early folks, like me. Instead, I am heading out for a 35 minute jog up the mesa in the woods behind our Technical Area. The air is crisp today, but dry and warm enough to wear shorts. This is a time for me to break the hectic pace of the day and actually have some time to think about problems/issues. I will see my usual running and walking buddies out there—the theoretical and particle physicists, the computer system managers, the environmental scientists, and technicians. When the snow covers the trail, we have a wonderfully equipped Wellness Center to help keep in shape. I often make contacts with past and potentially new clients at this facility.

After a working lunch, I am energized and ready for the afternoon. After loading some MATLAB simulation codes to run, I spend a few minutes consulting our group's statistics library of books and journals to check out alternative forms of the Weibull for use in our reliability modeling. Then someone comes in with good news about the proposal we sent out for funding additional work on fuzzy control systems. A colleague and I submitted an invited abstract for the PSAM conference next September, and this paper relies on the research from that proposal. We spend some time discussing how to tackle the problem of large uncertainties and information loss that might occur using rule-based methods. In certain cases where uncertainties are great and rules are not well defined, mapping of the rules into a performance measure results in a bimodal distribution which makes little sense given the physical interpretation of the problem—i.e., the mass should be concentrated at the center. But the mass at the nodes is indicative of the true state of knowledge prior to mapping. So we have our work cut out to try and determine the extent of information change/loss in the mapping, and explore alternative approaches. Fuzzy control engineers are just now beginning to work with statisticians. We are collaborating with those engineers here at the Lab, at the University of Alabama and at the University of New Mexico.

After this meeting, I remember to check my code results and load new ones on my Mac. To begin that walk-in dose-response model, I consult with our S-Plus and SAS expert in the group to see which software package might work the best. So now, the SPARC computer is running some SAS

PROCS. Most of us have two computers in our offices, and also have networked access to the Laboratory's central computing facility which includes supercomputers and connection machines. I smile thinking how efficient it is having both my workstations doing work for me at the same time.

While the computers are busy, I pause thinking (and dreaming) about this research, our collaborations, new statistics that can emerge from the work, how that fits into other projects we have and other statistical efforts, and where we will submit this work. The result of this mental exercise is to go back to the library and do some research. There are papers on the bimodal problem in the fuzzy sets journals.

The phone rings again with some news along the lines I was just contemplating. A probabilistic risk assessment engineer from one of the other groups within our division is calling to set up a meeting with some weapons designer physicists. Our two groups often work together, and we jointly submitted a proposal for a multiyear project with the physicists. Calling this meeting to begin defining the problem is a good sign that our proposal may be accepted. So far, it sounds as though the work may involve everything from analysis of megabytes of multivariate data to estimating effects from extremely sparse data availability. It will likely involve the following statistical methods: experimental design, Markov chain Monte Carlo, uncertainty analysis, data pooling, and data mining.

One last look as some final code runs, and time to back everything up for the day, tie up some communication loose ends, and shutdown the computers. At 4:00 P.M., I meet my husband (an engineer at the Lab) at our sport utility vehicle for our 15-minute drive home. A few minutes later, our 17-year-old son leaves his part time programming job at the Lab, which is part of his high school program.

I try not to take work home, but do take time there to think and reflect on the technical and administrative problems/issues. When necessary, it is relatively easy to get things done at home because our Mac system is even better than mine at the office. Also, my husband and son can solve every computing problem that I encounter. That's my high tech family, and that's my life as a statistician at Los Alamos National Laboratory.

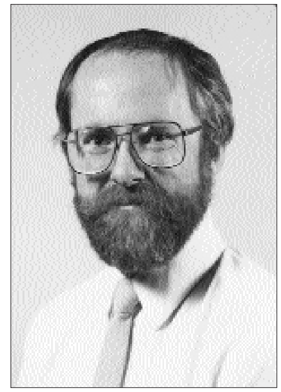
Bob Stephenson
Professor of Statistics
Iowa State University

Dr. STATS is always willing to try to answer any question you have, but as we head into the home stretch of the academic year, Dr. STATS has a question for you: So what are you going to do after you graduate? For many soon to be graduates, getting a job is as daunting a task as getting the degree. To help with the task, *STATS* has assembled a distinguished panel of statisticians to share their views on how to get a job in industry, academia or government. Bruce E. Rodda, Gary C. McDonald, and George Casella participated in a panel discussion, "How to Get a Job Anywhere," held during the Joint Statistical Meetings in Anaheim, California. Peter A. (Tony) Lachenbruch and Geraldine Stevenson now join them to cover the government sector, an important source of jobs for statisticians.

For those of you in the process of interviewing, or those planning to interview at the Joint Statistical Meetings in Dallas in August, there are many helpful hints. Even if you are not looking for a job now, you will be eventually. There is also some valuable information on how to prepare yourself technically before you finish your degree. In reading the contributions don't restrict yourself to one area (industry, academia, or government) but consider all of them. What helps one person to get a job in industry can very well help another to get a job in academia or government.

We begin with two statisticians from industry, Bruce Rodda of PPD Pharmaco, Inc. and Gary McDonald from General Motors. Rodda is Vice President for North and South American operations for PPD Pharmaco. He has 25 years of experience in many aspects of pharmaceutical research, having also worked for Eli Lilly, Merck, American Home Products, Bristol-Myers Squibb, and Schering-Plough. Formally trained as a statistician with a Ph.D. in Biostatistics, he is a Fellow of the American Statistical Association, and a Fellow and Chartered Statistician of the Royal Statistical Society.

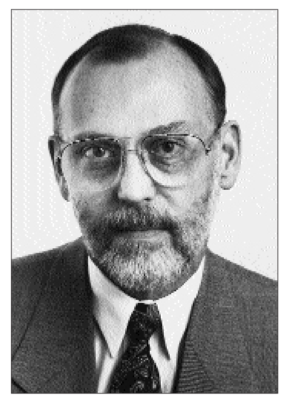
Gary McDonald is head of the Operations Research Department of General Motors Global Research and Development Operations. He is a Fellow of the American Statistical Association, Institute of Mathematical Statistics and the American Association for the Advancement of Science (AAAS). McDonald serves in various capacities with the National Research Council, the National Institute of Statistical Science, and the MATHCOUNTS Foundation. He is a candidate for President-elect of the American Statistical Association.



Bob Stephenson

How to Obtain a Position as a Statistician in Industry

Bruce E. Rodda
Vice President, Operations–The Americas
PPD Pharmaco, Inc.
Austin, Texas



Bruce E. Rodda

There are three principal components involved in acquiring a challenging and rewarding position in industry. These are:

- Getting the necessary training,
- Learning about the particular industry and the roles a statistician plays,
- Getting the job.

Each of these elements is critical to a successful job search.

Getting the Necessary Training

Sound theoretical training is a fundamental requirement for a statistical position in industry. In general, an advanced degree in statistics (either an M.S. or Ph.D.) will satisfy this requirement.

A successful industrial statistician must also have a methodologic facility, i.e., the ability to use the theoretical training acquired in graduate school. Your ability to formulate and solve problems in a multidisciplinary environment will be critical to obtaining a position and, to an even greater extent, being successful. Course work provides the tools; the ability to use the tools to formulate and solve real world problems is what companies look for in a statistician.

Potential employers will expect a statistical candidate to have outstanding computer skills. Although the statistician must possess these skills, he or she will not be hired as a computer expert. Most companies have computer experts who will assist statisticians, allowing them the opportunity to do what they were hired to do—be statisticians.

A point often overlooked in the training of statisticians is that most industrial statisticians are intramural consultants for their companies. Since more than 90% of all graduates in statistics have careers outside academia, it is important to emphasize that the activity that occupies most of an industrial statistician's time is not data analysis; it is communicating. Many statisticians fail in industry because of poor verbal and/or written communication skills. The ability to formulate a problem with others, develop a plan for solution, and summarize the results and conclusions without statistical jargon is essential for success. Individuals who are not confident of their ability to communicate, both verbally and in writing, should take focused training while in graduate school. It's worth the effort.

In addition to sound statistical and communication skills, your likelihood of getting the job and being successful in it will depend heavily on your knowledge of the specific area in which you will be working. An ideal preparation would be to minor or take course work in engineering, biological sciences, business, or the field in which you will seek employment.

Learning About the Job in Advance

When considering a position in industry, bear in mind that the environment will be very different from that of academia. Whereas in academia an individual is rewarded for personal accomplishments, the culture in industry focuses more on strategizing, problem identification, and problem solving. With few exceptions, these challenges are multidisciplinary. Success rests on the ability to work collaboratively.

There are no "statistical" problems in industry, but all problem resolution will use the statistician's training. A statistician who feels that his or her role is to analyze a physician's or an engineer's data will not be successful. Success in this collaborative culture will require a thorough understanding of the total environment. The successful statistician must be a leader in problem identification and formulation; he or she cannot wait for the problem to be presented by others. Industry does not want "statisticians;" they want problem solvers who are also statisticians.

It is also critical to acquire a basic appreciation of a statistician's role in the particular industry of interest. This will have two obvious effects. First, it will allow you to decide whether you would like to pursue a career in that industry. Second, it will help you to develop a career plan and to hit the job running.

Getting the Job

You have the skills; you've investigated the industry; and you've chosen some companies to which you plan to apply. What will maximize your chances of getting the position you want?

- Have a well prepared resume. Take the time to get expert advice on the preparation of your resume. Your resume is the first contact a prospective employer will have with you—make it perfect. Candidates are often rejected simply because their resumes had typographical errors or poor grammar. The reasoning behind the initial rejection is that candidates who show traits of carelessness or poor writing skills in resumes may do the same on the job.
- Study the company. Each company is unique and has a corporate pride. Learn as much as you can about a company and personalize all communications. This is critical if you have an opportunity for an interview. Explore the company's Web site, read information available from investment firms, or contact associates who can give you information.
- Send a copy of your resume and personal letters to the head of statistics and to the head of human resources. These letters should not appear to be form letters. Do this even if you are responding to an advertisement listing only one contact person. The more people who are aware of your interest, the better.

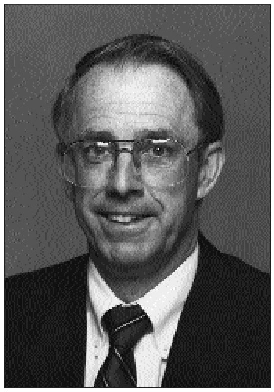
It is unlikely that you will receive a response to your resume. Companies are very busy and cannot respond to the majority of resumes they receive. Therefore, call. Calling both the head of statistics and the human resource contact will show your interest and distinguish you from other candidates.

- If you are invited for an interview, again seek professional advice for specific help in presenting yourself to your best advantage. Dress well, study the company as much as possible, and have some short term career objectives. After reviewing both the company and the roles and responsibilities of the position for which you are interviewing, you can tailor your goals to match those of the position.

Obtaining a challenging and rewarding position in industry is both art and science. It requires significant planning and perseverance. If you follow the suggestions above and seek professional advice, you will maximize your probability of getting the job you want. It's one of the most important activities you will ever do, and a full time job in its own right. Don't approach it casually.

How to Get a Job: Industry

GARY C. MCDONALD
Operations Research Department
General Motors Global Research and Development Operations



Gary C. McDonald

I have had the experience of searching for jobs, writing application letters, and going on interviews, mostly in the early part of my career. Over the latter part of my career I've spent lots of time receiving applications, interviewing candidates, and selecting candidates to invite to join our research staff. Drawing on this experience, I have come up with eleven points which, in hindsight, help make the difference between those invited to join the staff and the others.

Build expertise around hobby interests.

It is fun and invigorating to work in an industry and a job that you genuinely enjoy—the products really do interest you. To help put yourself in a position to get such a job, take courses to reinforce your interests outside of statistics. Join organizations or clubs that build on your interests, and take part in competitions that challenge you in these areas. Then apply for the job. For example, if you really are a car "buff," then apply to GM (or Ford, Chrysler, or Toyota) for a job utilizing your statistical skills. You'll really enjoy putting your expertise to work on products or services that excite your imagination and for which you've developed a hobby perspective.

Generate a technical record of achievements and computing skills.

There is no substitute for doing well at what you do. Work hard to generate a record of achievement that reflects well on both your abilities and your perseverance. Computing will continue to be an important facet of a statistician's makeup. In your computing background, it will help to have experience with database management and with spreadsheet applications. Spreadsheets are the "common language" of the finance and business planning community, and spreadsheets (e.g., Excel) continue to incorporate analytic capabilities. We are finding it easier to transfer new analytic tools for use in the corporation if they are imbedded in the "common language," i.e., spreadsheets.

Have an internal reference accompany your application.

Most applications that arrive at a company arrive at the personnel department with a rather impersonal greeting. A more effective strategy is to send your application to some responsible person in the company who, in turn, can append his or her recommendation to it and direct it to the relevant department. How do you get such a contact? Figure out ways to network for this entry point. For example, make contacts at professional meetings. Seek out speakers that might be from a company in which you might have interest and see if you can arrange a time to talk and informally let him or her know of your interest and skills. Utilize the alumni from your school or department who might be working at that company. See if your faculty might be able to introduce you to such a contact.

Present yourself with neat, professional correspondence & appearance.

First contact with a potential employer is perhaps the most important. It's generally assumed that applicants are never on better "guard" than when they seriously inquire about employment opportunities. Pay attention to writing—spelling errors, grammar errors, poor format all indicate that the applicant is either not very careful or is lacking in communication skills. Dress "appropriately" for interviews and personal contacts. What is "appropriately?" A good rule-of-thumb is to present yourself in a manner that your appearance and dress are not a distraction to your audience. With respect to clothing, you can be inappropriately underdressed as well as overdressed. You want your potential employer and colleagues to focus on your ideas and discussion—not on dress and appearance incidentals.

Develop a good knowledge of my companyflits products, challenges.

Before going to a company for an interview, do take the time to learn about the company—it's products, services, current challenges, and even its history. Some of this information can be obtained through Web sites, trade magazines, and some library work. I also suggest reviewing the latest copy of the annual report. This document provides lots of financial information about the company. Additionally, it focuses discussion on the goals and current challenges of the company and will give you some knowledge of company priorities.

Talk company problemsflnot just technical jargon.

When visiting a company on a job interview, make sure that you talk about the company problems in addition to your technical areas of expertise. Learn as much as you can about the business problems of the organization. Find out about your potential manager's responsibilities, since if you work there, you will be expected to help him or her reach their objectives.

Give me an extraordinary reason to hire YOU.

Give your potential employer the extra reason why you are to be preferred over other applicants. This might be intern positions, summer jobs, other relevant experience, and/or extra course work in a particular area. Highlight these extraordinary reasons in your correspondence and your interviews. This can be the tie breaker between you and another applicant.

Demonstrate a broad perspective and a willingness to learn and try new ideas. Be flexible.

Show a willingness to continue learning. Many companies offer continuing education programs. Inquire about these and check on their availability to you. Do develop good reading and memory skills. As you begin work in industry you will be exposed to lots of articles and reports. It will be to your advantage to read effectively (rapidly with comprehension) and memorize selected items. This will set you apart from many of your colleagues.

Demonstrate excellent communication and listening skills.

Good effective communication skills are a real asset. Work on this in school—classes, seminars, workshops. As students, you've been exposed to faculty that provide excellent examples for you—both good and bad. You should learn from each of these. In industry, you must sell! It may be that you sell a product, a service, or an idea you want implemented. But you must sell! Good verbal and writing skills are very important and should be actively addressed in your student life. Learn how to focus messages to meet the needs of the audience. And, yes, there is a need to listen intently and carefully!

Show that you are a good team player

Most projects in industry are team projects. Even if you are involved in a research function, as I have been, there will be a team effort that works on the implementation of the project with which you are involved. Do you have some examples where you have been a substantive team player? If so, emphasize these in your resume. You might wish to draw on some of your extra-curricular activities for this purpose.

Be persistent & polite in follow-ups to contacts & interviews.

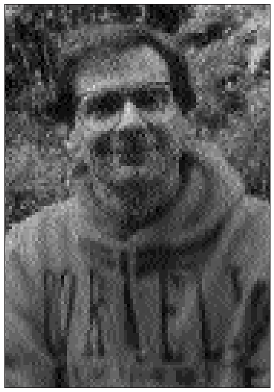
In your interviews establish dates for the next steps. Identify appropriate contacts with whom to follow-up, and do follow-up. Do so in a polite manner and be persistent.

One final note in closing. Usually when an interviewee comes to our site for an interview, we know a lot about him or her. We have academic records showing the courses taken and grades received. We have letters (or phone conversations) with prior employers and/or faculty advisers. We may have letters of support from internal staff who are familiar with the interviewee. In brief, we probably know as much as we need to about the technical side of the individual. So why a face-to-face interview? Because ... Interviews are more about "chemistry" among people rather than completing a technical checklist. The interview provides you with an opportunity to give me an extraordinary reason to hire YOU, and provides our staff with an opportunity to assess your interpersonal skills and how well you might fit into our organization. Do prepare yourself well and make the most of the opportunity—both you and the employer have lots to gain!

George Casella, the Liberty Hyde Bailey Professor of Biological Statistics in the College of Agriculture and Life Sciences at Cornell University adds his insights on getting a university job. George is active in many aspects of statistics. He has contributed to theoretical statistics, in the areas of decision theory and statistical confidence, and has more recently concentrated efforts in environmental statistics. He now runs a doctoral training program in environmental statistics funded by the National Institutes of Health. A Fellow of the American Statistical Association and the Institute of Mathematical Statistics, George is currently the Theory and Methods Editor of the Journal of the American Statistical Association (JASA). *He has authored two textbooks* (Statistical Inference, *1990, with Roger Berger and* Variance Components, *1992 with Shayle Searle and Charles McCulloch), and is currently working on a revision of* Theory of Point Estimation *with Erich Lehmann.*

How to Get a Job in Academia

George Casella
Professor of Biological Statistics
Cornell University



George Casella

As I sit down to write this piece, I not only have the advantage of having been at the session in Anaheim, but also in seeing the draft of McDonald's contribution. Virtually everything that the other contributors say also makes exceptionally good sense for getting a job in academia. So take all of the other advice to heart. Here I will add to, and expand on, a few topics.

At the Anaheim meeting I told a joke about a rabbit, a fox, a wolf, and a lion, which had a punchline about major professors. The point of telling the joke was to underscore the importance of making yourself (and your resume) stand out. It is an unfortunate fact that an academic position in statistics will attract upwards of 100 applicants, and sometimes initial screening is quite cursory. What criteria will get you past the initial screen? Your school, your major professor, your thesis topic, your recommendation letters, and your unique qualities.

The first four criteria may be somewhat out of your control, but you can work on your uniqueness. Have you taken courses outside of mathematics and statistics? Have you done any interesting applications? Have you participated in consulting activities? Have you worked? (Internships are very well thought of.) Can you teach? Have you taught? Think hard about these points, and highlight the qualities that you have that will make your resume stand out.

When you get an interview, then the real work starts. It is extremely important to know who you are going to meet. (Most departments have a Web site, so it is easy to find out the faculty and their interests.) Then when you interview with them, you should be able to ask them questions about their research, both past and future. The added benefit is that you can also get some idea about how they will fit in with your future plans. If you do get an offer and take the job, these will be your colleagues. Do you want to work with them? Are you interested in the kinds of problems that they are working on? Can their areas of expertise help further your career?

You should also find out a bit about the mission of the department. Is it primarily a teaching department? Do they do a lot of consulting and collaborative research? How will you fit in with the graduate program? Does the expertise that you bring enhance the existing program? During your interview, you should address your potential contributions in these areas.

It is probably a good idea to visualize your job search from the other end. That is, put yourself in the role of the people who are interviewing you. What do they want to see? They probably want someone who can hit the ground running. Can you walk in and teach their intro stat course? If so, let them know. Can you join in their consulting obligations? Do you have future research plans? How do they fit in with those of the department? Try to show the department how you will be a benefit to them.

Lastly, and perhaps most importantly, you must present yourself well. This applies to all aspects of your interview. In particular, your seminar should be well prepared and well delivered. Your dress should be appropriate (McDonald said this best at Anaheim when he said, "Take dress out of the picture.") You want to be judged on your potential, not on how you look. (A personal aside that you may have not considered: a past interviewee at Cornell did not "take dress out of the picture." This did not matter at all to the department, but caused us problems because it biased the Dean.)

A final thought: make sure that you interview them! This includes not just academic considerations, but the non-academic side of the position. What kind of health plan, what kind of retirement plan, etc. Although you may not consider such things to be important at this early stage of your career, they are.

Your first job will set the stage for your career. Weigh all possibilities, and make sure that you choose the position that will serve your career best.

Peter Lachenbruch is chief of the Biostatistics Branch of the Center for Biologics Evaluation and Research (CBER) in the U.S. Food and Drug Administration (FDA). Prior to joining the FDA, he held faculty positions at University of North Carolina, University of Iowa, and UCLA. He has been active in many professional associations including the American Statistical Association (of which he is a Fellow), the International Biometric Society, and the American Public Health Association. Geraldine Stevenson is the Personnel Specialist in the Office of Establishment Licensing and Product Surveillance at CBER. She is involved with all aspects of personnel practice including recruitment, promotion, and performance awards. They will discuss getting a job with the U.S. Food and Drug Administration specifically but also with the U.S. government in general.

■ Applying to the Food and Drug Administration for a Job

PETER A. LACHENBRUCH AND GERALDINE STEVENSON
U.S. Food and Drug Administration

Peter A. Lachenbruch

Geraldine Stevenson

Introduction

We will discuss several issues involved with getting a job at the Food and Drug Administration. Peter Lachenbruch, as a Biostatistics supervisor, is in charge of finding and recruiting good statisticians for his staff. Geraldine Stevenson, in her job as Personnel specialist, conducts hiring practices in accordance with legal procedures. We work together to assure that the best qualified individuals are hired and that the process is fair. The issues we will discuss include:

a) How does a position become established?
b) How can I find out about a job?
c) What information should I submit?
d) Procedures the FDA must follow.

How does a position become established?

The managers (Office Director, Division Director, Branch Chief) determine if the Division or Branch needs a new position to accomplish its mission. Once we make this decision, we request the personnel office to establish and classify this new position. The Office or Division initiates the search for qualified candidates to fill a position. The managers decide how wide the job search should be. It may be CENTER-WIDE, FDA-WIDE, GOVERNMENT-WIDE or ALL SOURCES. A CENTER-WIDE search occurs when there are enough qualified candidates to apply in a short time frame.

An FDA-WIDE search is used to reach a variety of specialized experienced candidates within the Agency. GOVERNMENT-WIDE searches include candidates from other agencies. ALL SOURCES alerts prospective candidates from the outside who are not currently employed with the Federal government. We do this type of recruitment by publishing a vacancy announcement. The Center for Biologics Evaluation and Research (CBER) at FDA does most statistical recruiting from ALL SOURCES. Another type of recruitment is through the Open Continuous vacancy announcements which are opened for at least six months or until further notice. This allows time for candidates to apply for hard to fill positions that are constantly in demand. Some of these Open Continuous vacancy announcements are: Biologist, Chemist, Computer Specialist, Consumer Safety Officer, Medical Officer, and Pharmacologists. Most statistical positions are advertised for the specific position rather than open and continuously.

How Can You Find Out About Jobs?

CBER advertises and posts jobs in several places. For statisticians, we advertise in the *Amstat News* giving a brief description of the job duties, salary, and where to submit a curriculum vitae or SF-171. The vacancy announcement (see sidebar) gives the opening and closing dates [1], position [2], grade [3] and series [4], salary range [5], area of consideration [6], type of appointment [7], relocation expenses (paid or unpaid) [8], duty location [9], job summary [10], qualifications [11], evaluation method [12], knowledge, skills and abilities required [13], how to apply [14], and the address to submit requested information and documents [15]. Jobs are also posted on the FDA Web site [*http://www.fda.gov*]. For each job, it is important to note two things: the closing date for the application and the Knowledge, Skills and Aptitudes (KSA) that are required. If your application arrives after the closing date, there is no longer a five day grace period to submit the requested information.

Your application should address the required KSAs. This will assist the personnel specialist to assess your application. We include a sample job advertisement for a recent mathematical statistician position. We have indicated the relevant parts of the ad by numbers.

What Information Should I Submit?

There are two ways to submit a job application. You can submit a resume which addresses all of the KSAs in the advertisement. The typical material includes your education, your job history, your research record, your teaching record (if applicable), your availability (when you can start, etc.). A second, more traditional way is to submit the Federal Employment Application (form SF-171) or OF-612 (Optional Application for Federal Employment). The Federal government does not require a standard application form for most jobs. We need certain information to evaluate your qualifications for

Federal employment. For all scientific positions with specific education requirements, submit a transcript with your application. For mathematical statisticians in the 1529 series, your transcript must show at least one year of Calculus and one year of Statistics. Since the series ranges from GS-7 to GS-15, the minimum requirements would apply to the GS-7 level employees, but considerably higher (for example, M.S. or Ph. D.) requirements usually apply to GS-12 and above positions. The pamphlet OF-510, OPM, *Applying for a Federal Job* is helpful (available in Post Offices and Federal Agencies, or the Office of Personnel Management).

What Procedures Must the FDA Follow?

FDA must follow some required procedures. After advertising the position, we must provide a minimum of three weeks, and sometimes longer for candidates to respond to the ad. When a position is advertised in a national journal, we often give several months from the time of ad submission to allow for publication delays. The personnel specialist reviews all submitted applications for completeness before evaluating them for basic qualifications for the position. Incomplete applications do not receive further consideration. Managers may elect to have the rating and ranking done by a personnel specialist or by a Quality Review Board (QRB). A QRB consists of five members consisting of an Equal Employment Opportunity (EEO) specialist, a personnel specialist, and three scientists with knowledge of the position and its duties (in our case, mathematical statisticians). In either case, the rating and ranking will refer to the Knowledge, Skills, and Abilities (KSAs). The personnel office sends the supervisor a certificate of the top (usually three) eligible candidates for selection. The supervisor will contact references, and make his choice. The personnel office will then contact the candidate and make the job offer. Note that only the personnel office can make the official job offer.

Example Ad

The Division of Biostatistics and Epidemiology, FDA/CBER is soliciting applications for positions as Mathematical Statistician [2] (GS-1529) [4]. Grades may range from GS-12 (50,040 to 62,910) to GS-14 (64,288 to 82,369) depending on qualifications [3] [5]. The duties of these positions are to review pre-licensure applications for Biologics products, conduct research relevant to product approval, and participate in creation of policy documents. The Center for Biologics Evaluation and Research reviews Investigational New Drug and Licensing applications of products derived from biological (as opposed to synthesized) material. These positions offer the opportunity to contribute to the public health and expedite the review of major and novel products. Our statisticians are in a pivotal position in these reviews. There are wonderful opportunities for applied Biostatistical research in clinical trials design and analysis in the drug development context.

There are opportunities to develop collegial relationships with leading scientists and statisticians in clinical trials and drug development. [10] Applicants should have doctoral level training in Statistics or Biostatistics or the equivalent in experience and professional development. Familiarity with the approval process, Blood Products, Therapeutic Products, or Vaccine Products are strong assets. Good written and oral communications skills are imperative. [11] [13] The successful candidates will interact with reviewers, advisors and industry from many disciplines.

The FDA is a family friendly workplace with flexibility in working hours and excellent benefits package. This recruitment is contingent on the availability of funds.

The Food and Drug Administration is an Equal Opportunity Employer. FDA is smoke free. Candidates should submit form Federal Form SF-171 (available at Post Offices and Federal Buildings) or a resume. [14] Submit this to

CBER Operations Team
1401 Rockville Pike, HFM-122
Rockville, MD 20852. [15]

If necessary information is not included on your resume, we will contact you for the additional data.

Opening date: December 15, 1997
Closing date: January 31, 1998 [1]
Relocation Expense: unpaid [8]
Duty location: Rockville, Maryland [9]

U. S. Citizenship is required for permanent employment in the GS series.

Permanent Residents may apply for Staff Fellow positions. Such positions use the equivalent salary structure as the GS series. These are limited term appointments which may be renewed for up to five years total appointment. They require that the candidate be eligible for Citizenship by the end of the fourth year of the appointment. [7]

Contact Peter A. Lachenbruch, Chief, Biostatistics Branch at lachenbruch@a1.cber.fda.gov if you have questions about

JERRY KEATING
Professor of Statistics
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STATS Quotes

The following noxious quote comes from the renowned Irish poet, W. H. Auden, in his first commandment to poets.

"Thou shall not sit with statisticians nor commit social science."

As a footnote, did you know that the Belgian statistician, Adolphe Quetelet, is known as the Father of Social Statistics? Quetelet is the first scientist to use the term, "Average Man," and February 1996 marked the bicentennial of his birth.

The following quote appeared in the November news issue of the *Royal Statistical Society*. These are the first two sentences in a June 1997 article, entitled "Why Women are Different," of *Good Housekeeping* (British edition):

"Women may be shorter and lighter than men but they're no longer the weaker sex. In every age group, 100 men die for every 64 women."

Charles Grinstead suggested that the authors of the *Good Housekeeping* article were saying that for all age groups, the death rates of women are 64% of those for men. He corroborated his interpretation using data from the 1990 U.S. census. J. Laurie Snell in *Chance News*, Issue 6:13 verified this interpretation using a mortality table, which is given in Table 1, based on U.K. data for 1995. Mortality tables start with 100,000 persons at birth and estimate the number living at the beginning of the next stage.

Notice that the female death rate (fdr) corresponds well with the male death rate (mdr) for the previous five-year interval past the age of 35. So the female death rate as a percent of the male rate supports an overall assumption of 64%. The estimate of the life expectancy of men based on this table is 73 years, whereas for women it is 78 years. Evidence indicates that there are about 105 male births per 100 female births. Using mortality rates given in the 1995 U.K. mortality table, at what age would there be approximately the same number of women as men?

Table 1.

Age	males	females	mdr	fdr	fdr/mdr
0	100,000	100,000	0.008	0.006	79.5%
5	99,185	99,352	0.001	0.001	73.6
10	99,105	99,293	0.001	0.001	69.5
15	99,003	99,222	0.003	0.001	43.8
20	98,714	98,095	0.004	0.002	36.2
25	98,296	98,943	0.004	0.002	42.1
30	97,864	98,760	0.005	0.003	51.5
35	97,360	98,498	0.007	0.004	60.1
40	96,710	98,103	0.010	0.007	66.6
45	95,725	97,438	0.016	0.011	68.2
50	94,223	96,396	0.028	0.018	64.3
55	91,607	94,675	0.047	0.028	60.1
60	87,315	92,010	0.080	0.048	59.4
65	80,293	87,617	0.135	0.080	59.1
70	69,449	80,627	0.210	0.128	60.8
75	54,848	70,313	0.315	0.201	63.8
80	37,573	56,187	0.449	0.317	70.6

STATS from *Amstat News*

In the December 1997 issue of the *Amstat News*, the ASA's Executive Director Ray Waller released the salary summary in Table 2 for assistant professors at Research Institutions, which grant the Ph.D. degree in Statistics. Salaries are based on nine-month appointments.

Table 2.

Years	#	Q_1	Q_2	Q_3
1 or less	26	46,000	**48,000**	60,750
1992	19	38,000	40,500	42,000
2 years	19	41,900	**46,300**	50,200
1992	19	39,000	42,000	45,300
3 years	13	43,550	**47,593**	52,850
1992	20	38,700	40,200	42,500
4 years	13	44,800	**47,800**	55,200
1992	16	38,650	39,900	44,600

The column headed by years refers to the number of years in rank of the professor, # refers to the number of respondents in each category, and Q1, Q2, and Q3 are respectively the first, second and third quartiles of each group.

You have no doubt heard about faculty salary issues within ranks, including salary compression and inversion. Salary compression has many facets. The most obvious facet is that new salaries drive up salaries in the market place. This often leads to incongruencies in salaries such as beginning assistant professors making nearly the same as other assistant professors with as much as four years of experience. In some cases, new salaries exceed salaries of more experienced persons creating salary inversion. Do these data exhibit salary compression or inversion? How would you present these data so that salary compression or inversion could be easily grasped? If one uses regression analysis to predict salaries based on experience, how well would salaries correlate linearly with years in rank? Would the correlation be positive or negative? Estimate the average salary paid to an Assistant Professor, who teaches at a Ph.D. granting school and has at most four years in rank in 1997.

Within each year, I included the same salary figures for the 1992-93 academic year. Do both years reflect a pattern of salary compression or inversion? Has the pattern changed over the years? How would you depict the differences?

As a point of reference, in 1981 my starting salary as an assistant professor of Statistics was $18,500. In 1972, I taught high school mathematics in Wichita Falls, Texas for $6,600 for nine months and $300 of that salary was for being golf coach. I was as badly overpaid as a golf-coach as I was underpaid as a teacher.

STATS from Science and Weather

Seen Elsewhere in *Chance News*, Issue 6.13, by J. Laurie Snell, Dartmouth, and the *Boston Globe*, December 2, 1997 by David Chandler.

As the evening news brought new reports of the havoc wrought by the latest recurrence of El Niño, most Americans saw very mild winters in the northern tier of U.S. states and unseasonably wet winters across the West Coast, the Southwestern and Southeastern U.S. California bore the brunt of this weather phenomenon, which was produced by warming of Pacific Ocean waters along the equator. Can this warming actually be a precursor to the next ice age?

Emerging evidence indicates that at the end of the last ice age, circa 9600 B.C., worldwide temperatures changed at a much faster rate than that predicted by today's computer forecasts for global warming. In some locations, average temperatures changed by as much as 18 degrees Fahrenheit over a period of several decades. This large temperature shift contrasts sharply with computer models that show global warming from greenhouse gases unfolding gradually over the next century. The historical record shows that some threshold is crossed, beyond which changes of devastating proportions take place very rapidly.

In a recent article in *Science*, climatologist, Wallace Broeker of Columbia University, argues that abrupt changes in ocean currents are the only possible explanations for such large changes. His perspective is consistent with that of an MIT study published in *Nature*. The MIT study analyzed sediment cores extracted from the ocean floor off the coast of Bermuda. The study concluded that climatic shifts are related to deep-water re-organizations and that these can occur within a few hundred years or less. In another *Nature* article, at the end of summer 1997, scientists reported that greenhouse gas buildup in the range projected for the next century could be sufficient to shut down an ocean circulation pattern known as the Atlantic Conveyer.

Ronald Prinn of MIT adds that it is conceivable that such a shutdown could trigger a new ice age and that some ice age models actually begin with global warming. Since current climatological models cannot model the known large temperature shifts of 9600 B.C., we have no way of meaningfully predicting whether we are at the brink of a next ice age. What did follow the last great El Niño of 1982–83 was an extremely bitter winter throughout the Central U.S. in December of 1983 and jet stream effects pushed this cold into the Southeastern U.S. during January and February of 1984. Most scientific models predict that this El Niño will continue through June or July. But the ends of these cycles are typically followed by abrupt shutdowns of moisture in the last few months of the harvest season. For cotton crops, such news is welcome but not so for many others.

Another negative correlation, worthy of mention here, is the bitterly cold 1978–79 winter, which followed the warmest summer ever recorded at the North Pole. So to find out if you will have a cold Christmas this year, you better call Santa Claus on Independence Day!

STATS Parodies

We continue a new section, STATS Parodies. In this issue we feature another parody by Professor Mark Glickman, Statistics professor in the Mathematics Department at Boston University. This parody is based on Bob Dylan's classic, “Mr. Tambourine Man.”

To get the full effect of Mark's contribution listen on Mark's Web site at

http://math.bu.edu/people/mg/music.html

Title: "Probability Man"
Words: Mark Glickman
Music: Bob Dylan ("Mr. Tambourine Man")

Hey Probability Man, flip a coin for me,
I don't study and I never really learned how to.
Hey Probability Man, roll those dice for me,
as you're walking to your classroom I'll come following you.

Help me take the steps to compute a cdf,
calculate a pmf, to derive an mgf,
and take limits from the left, just learning terms
won't help my understanding.
How hard can it be to integrate a density,
or to calculate a mean, or infer what is not seen,
I promise to learn Calculus.

Hey Probability Man, pick a card for me,
I don't study and I never really learned how to.
Hey Probability Man, spin that wheel for me,
as you're walking to your classroom I'll come following you.

My memory is gone when the process is Poisson,
or even Gaussian; my transforming is undone
with the wrong Jacobian, my mind's made up,
I need to understand you.
Teach me all you know, teach me now I cannot wait
to learn how to correlate, or when one should integrate,
I want to learn everything.

Hey Probability Man, flip a coin for me,
I don't study and I never really learned how to.
Hey Probability Man, roll those dice for me,
as you're walking to your classroom I'll come following you.

All you headbangers stay tuned to our next issue for Peter Westfall's parody of "Takin' Care of Business" by Bachman Turner Overdrive. If you have original songs or parodies of popular hits send them to me at the address below.

STATS Poetically

The poem, "The Respondent," featured in this section in a previous issue of *STATS* (1997, Number 18, p. 28), was submitted by Tom Lineham, former director of the Central Statistics Office in Ireland. This issue's poem by Michael Blumenthal speaks of luck, dumb luck, luck of the Irish, etc. But does the bard share our perspective on randomness and determinism?

Lucky

Michael Blumenthal

Off to the market to buy a lottery ticket,
I consider the possibilities of luck: good luck,
bad luck, beginner's luck, hard luck, the luck
of the draw, and realize I am lucky, in fact,
to be here at all, along this benignly lit street
on a night in October, as luck would have it,
and I know that it's not just the luck of the Irish,
but any man's, to walk the streets of his town,
beneath the shapely moon, and ponder
the dumb luck that brought him there, against
all odds, out of the vast lottery of minnow
and ovum, and that he has once again lucked out,
this very night, spent as it has been
without accident, a small testimonial
to the quietudes that are still possible,
the only half-felt wish for some grand stroke
of luck that will change everything, that will
change, really, nothing at all, our lives being,
in some sense at least, beyond the vicissitudes
of luck and longing, the night being lovely,
the day finite, many of those we know whose luck
has already run out, and we not yet among them,
thank the beneficence of Lady Luck,
our lucky stars just now flickering into flame
as the night lucks in.

Michael Blumenthal is the Briggs-Copeland Lecturer in Poetry at Harvard University. His book, *Days We Would Rather Know*, is a favorite of mine.

Do you have any interesting stories, anecdotes, jokes, cartoons, poems, or parodies? They may be fact or fiction, real world or theory. If so, send them to

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