Interview With Robert W. Hayden

Allan J. Rossman and Robert W. Hayden

Robert Hayden is retired from Plymouth State University and now teaches online for Statistics.com. He has been active in the Mathematical Association of America and the American Statistical Association. He frequently responds to questions about teaching statistics through various electronic discussion groups.

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Beginnings

AR: Thanks very much, Bob, for agreeing to this interview with the Journal of Statistics Education. Let’s start when you were 18 years old. Where were you, and what were your plans regarding education and career at that point?

RH: Wow, Allan, that was a long time ago! You expect an old guy like me to remember that far back?

Seriously, to understand where I was at 18 we have to go even farther back. I grew up in a poor family and in a rural neighborhood in Connecticut. Our nearest neighbors were cows! Mom didn’t drive until I was half way through school, so we were pretty isolated. My principal feeling was one of boredom. The high point of my childhood was learning to read in first grade. That opened lots of doors, and I thank my teacher, Sandra Jeffreys. After that, though, school was also boring.

In junior high school, my math teacher, Evan Lawn, convinced me that I would be a lot less bored if I got into a good college. He suggested that I work hard on my indifferent grades in the hope of obtaining a scholarship. So the next term I got all Bs and the one after all As.

Probably the next high point was the summer after my junior year of high school when I attended a summer institute in biology at Northeastern University. That convinced me I did not want to be a biologist, but more importantly, it exposed me to Boston. I was amazed to find entire stores that sold nothing but books! I came home with a pile of them. The following school year I received a full-tuition scholarship to MIT. So, at age 18, I looked forward to lots of intellectual stimulation from both MIT and the big city.

You may have noticed that I said nothing about what I planned to major in. First, I was more excited about the environment than what subjects I would study. I felt like I would develop specific interests after I got there. But I did have tentative plans: I enrolled as a mechanical engineering major. My interests then were more in things like economics, politics, and philosophy, but I did not see jobs for people with those degrees in the classified ads in the newspaper. Given my economic background, I was definitely interested in something that would lead to a job. I did have an interest in cars and some mechanical ability. My Dad was a mechanic (among many other jobs) and taught me a lot. When I was 17, I disassembled the engine of a car he owned that was making terrible noises and seemed to be on its last legs. I got it back together and it ran. Dad did not want to spend the money to fix the problem, but I did determine what it was, and that it was not serious. We got years more use out of that Buick. I always found it a blessing of being poor that our cars were of such low value that my father wouldn’t think twice about my taking one apart! Later I learned that knowing how to be poor was a valuable skill for a graduate student.

AR: That’s an inspiring beginning. Before we get to your graduate school days, let me ask whether MIT and Boston lived up to your 18-year-old expectations for intellectual stimulation.

RH: They certainly did! Both are a world onto themselves.

AR: Can you describe what MIT was like for you at that time, in terms of both coursework and experiences outside the classroom?

RH: Well, let’s start with life outside the classroom in Boston and environs. I think that’s easier to explain and easier to understand as it changed little while I was there. In addition to the book stores everywhere, there were at least half a dozen radio stations playing classical music. That’s been a major love of mine ever since. I visited numerous museums, and attended lectures on philosophy and psychology out in the suburbs. It was there that I met my friend Arthur Stenburg, with whom I had many all-night discussions.

MIT was more variable in that I liked some classes but not others. Chemistry was boring and so was the first semester of calculus. The final exam in calculus, though, was very stimulating! My teacher had spent most of his time doing homework...
problems from the text. The exam did not ask us to do that. Instead, it asked simple questions to see if we understood what was going on. I did not. I remember one question where I was asked to evaluate a definite integral. The question included the sadistic “[Hint: Do not anti-differentiate.]” Well, what was I supposed to do instead? After a while I drew a picture and shaded the area that corresponded to the answer. Then I could eliminate all but one of the multiple-choice answers. I found several other questions that I could answer just as simply. I realized I really did not understand the material very well, and vowed to learn it to the point where I could answer every question. A friend and classmate recommended his calculus instructor to me, so I semi-legally managed to get into his section second semester. The instructor was Arthur Mattuck, who, it turned out, had also been the author of that exam. (I think I was the only member of the freshman class who loved him for it—he got a lengthy chorus of hisses and boos at the start of the first lecture.) That exam, and Mattuck’s lectures, had a profound effect on my ideas on what it meant to understand something.

Wonderful as it was, my experience with calculus was just one of an unending array of examples of an atmosphere of brilliance. A part of freshman orientation was a lecture by Edwin Land in which he challenged previous theories of color. This was MIT’s idea of helping us to understand what the place was like! I recall a time about 15 years after I was there when many of the things I saw or heard at MIT popped up in the daily news, as though they had just been discovered yesterday. One of the things I saw or heard at MIT was computer aided design which I saw in a first semester engineering course. Many classes used no textbook because the material in them wasn’t in textbooks yet, or because the instructor had a radical take on what should be taught. I could go on and on. MIT was also very demanding. We students figured we could take one even a week away from our studies. I would not recommend MIT to everyone, but it certainly convinced me that not all colleges are the same. I encourage young people to put a lot of time and effort into finding a school that is a good match for them.

**AR:** Did you graduate with a degree in Mechanical Engineering, or did your studies take a different turn before that point?

**RH:** They took a BIG turn! One issue was that I became disillusioned with mechanical engineering. I was thinking of designing an entire automobile from scratch, but in fact the finance people come up with a price, the styling people a shape that won’t fit around the components, and the marketing people a list of “features” nobody needs. Then a big team of engineers gets saddled with making the unworkable work. That’s a pretty cynical assessment, and I know now there are exceptions, but most engineering jobs are not that creative. You end up trying to actualize the dreams of others. I had gradually realized that I wanted what I call “the life of an artist.” Not that I had any artistic ability. I just wanted to be doing something I was passionate about, and not worry too much about how well it paid.

Then there was the competition of MIT and Boston for my affections. All my outside passions meant my grades were just average. Average grades at MIT is nothing to laugh at, but after two years I lost the full tuition scholarship. They did offer loans instead, but it seemed that if I took those, I would HAVE to go into a high paying field to pay off the loans. So I dropped out of MIT to ponder what to do next.

**AR:** I must say that your story has me on the edge of my seat. I know that you did not become a writer of thriller fiction (at least I think I know that), and I also know that your story will turn to the study of mathematics and statistics at some point. Have we reached that point? What did you do next after dropping out of MIT after two years?

**RH:** I got a job—in a mechanical engineering lab! And an apartment in Cambridge within walking distance of MIT. So the time in ME was not wasted—it saved me from flipping burgers or digging ditches. But it was just a job—I rarely thought about it after hours. It was OK at first, but then business went downhill and I ended up the only technician in the lab. Then they hired a guy named Ron Tye with an international reputation in the field and things got very good indeed. He gave me free rein in the lab while he drummed up business. Gradually we hired and I trained several new technicians. We even got into some research projects and I had several publications—as a college dropout! It was fun, but still only a job.

In addition to training technicians, I also tutored one of them. Hal Spector was going to night school to get an associate degree in electrical engineering. He was really my first student. I enjoyed the teaching I was doing a great deal. In the meantime, my philosophical and psychological interests had converged on epistemology. I didn’t know what to do with that interest, though. I was out of sympathy with the then-current schools of philosophy and the then-dominant behaviorism in psychology. Maybe you can see where this is going!

I decided that I could study how people learn by trying to teach them and studying their response. My interest was in adults rather than children. I wasn’t aware then that statistical consultants in industry are teachers, so I decided to teach college students. But what would I teach them? I hope none of my former mathematics instructors are reading this, because I settled on mathematics not out of love, but because I was good at it and there are mathematics instructors at nearly every college. So we finally get to the part where I do something with mathematics—though perhaps some might say for the wrong reasons!

**AR:** You say that you decided to teach college students. You must have realized that making a career of this would require first returning to college yourself to complete your undergraduate degree and then pursuing a graduate program. Did you return to MIT as a math major?

**RH:** I did. The first year was rough because I had been out for five years and changed majors. And money was a constant problem. I mentioned the life of an artist earlier. In this case I quit my job and went back to school without thinking much about how I was going to pay for this. It was what I wanted to do so I did it. But I had established an excellent reputation in the lab where I worked and had a standing job offer for whatever hours I could put in. Juggling work and school I managed to graduate with a B.S. in mathematics from MIT in three additional years.

**AR:** Did you come to love mathematics, or perhaps to appreciate or enjoy it, during those years?
RH: I enjoyed it much as I enjoyed my engineering job. It was interesting and fun, but I did not feel passionately about it. In particular, I had no interest in doing mathematical research.

AR: Had you taken any statistics courses, or done anything yet with statistics, at this point?

RH: I almost said, “No,” but then I remembered. Just about everyone at MIT took the same math sequence in the first two years. We covered calculus with Thomas, differential equations with Kaplan, a bit of linear algebra with a locally produced booklet—and much of Freund’s math stat text. I read Freund and mastered it to the point of getting good grades on it but nobody ever told me what it was used for or why we were studying it. I never got the point and forgot the material as soon as I finished the exams.

However, your question does remind me that when I did get into statistics I felt like my engineering background was more help than my math background. Statistics and engineering rely heavily on concrete facts or data. Theory plays only a supporting role. And you always have to come up with an answer, even if it isn’t perfect or proven.

Graduate School

AR: What comes next? After you obtained your undergraduate degree from MIT, did you pursue graduate study right away?

RH: Yes. I grew up in Connecticut and had refrained from ever doing anything official in my ten years in Massachusetts, so I was still considered a Connecticut resident. So, I went to the University of Connecticut to pursue a Ph.D. in mathematics.

My time at UConn began well but as time went on my lack of interest in research and other things led to my being considered lazy or “not serious.” One of my “errors” was taking an undergraduate probability course. As I approached the point where I could claim a Master’s degree I began to research other graduate schools. I wrote a letter describing my interests and sent that to several. I hoped to find a school that was comfortable with what I wanted to do. For a while I got no response at all—just catalogs and application forms.

One day when I felt particularly discouraged I happened past a bulletin board with posters advertising graduate programs elsewhere. I assume it was aimed at undergraduate math majors, though many of the posters seemed aimed at convincing faculty elsewhere how great a program was. I saw one from Iowa State that sent a warm welcome to prospective students. They even had a pad of prestamped postcards so you could inquire for free. Iowa seemed very far away, but I was so happy to find a place that sounded like they actually wanted graduate students that I sent the postcard in on a lark. I followed it with the letter nobody wanted to answer.

To my surprise, I received a personal response from the department’s math education person, Bill Rudolph, and the chair, Will Barnes. Both said the same thing: that they did not have such a program, but they did have plenty of mathematics and education courses, so I should come out and sit down with them and design a program to fit my needs.

It was an offer I couldn’t refuse, so I figured it was time to revert to artist mode. I bought a 17-year-old pickup truck and filled it with as many of my belongings as fit and headed for Iowa.

AR: Were your hopes realized in Iowa—were you able to design a program to accomplish your goals? What did your program entail?

RH: Yes. ISU originated as the Iowa State College of Agriculture and Mechanic Arts. That practical outlook made the atmosphere more like I had enjoyed in engineering. The main emphasis was on getting the job done. Egos and politics were not issues, or at least did not affect me much.

The program was pretty much designed by me with a few alterations by my committee. I only remember odd bits and pieces now. There was plenty of math—combined with my prior coursework there were more courses than most math Ph.D.s take. However, the courses were very diverse. There were also quite a few education courses, but a fair number of courses in other departments as well. I had discovered Piaget by then and so I included a course from the Psychology Department on interviewing. I know I took a sociology course because I remember informal consulting work with the instructor, helping him to figure out the math in some research he was involved with. I think the course on computers in education was in the Computer Science Department. (I had taken a FORTRAN course at MIT). By the way, that sociology professor was not the only professor there willing to learn from a graduate student. The place was very egalitarian.

Allan, while we have been talking I have been working on a regression model, and it predicts you will ask me if I took any statistics courses at Iowa State. Yes, I did. The education people insisted I take an introductory course, but I elected to do that in the Statistics Department. The course was well-taught, and we had regular computer assignments. That had an influence—I’ve always thought that to be a normal part of any statistics course. I also took a sampling course. That was pretty standard fare out of the book by Dick Scheaffer and friends. Back then it did not explain the mathematics behind what they were doing. That annoyed me, so I looked for enlightenment elsewhere and found Cochran’s sampling text. I think that was the first contact with statistics that actually excited me. I found the proofs I liked from mathematics and the practical wisdom I liked from engineering.

AR: Yes indeed, your regression model correctly predicted exactly what I was thinking to ask at that point! Now let’s continue chronologically: What did you investigate for your Ph.D. dissertation?

RH: Actually, my dissertation topic was my one big disappointment at ISU. My original proposal was to interview math professors to identify a list of things students constantly had trouble understanding. Then I would select from that list and offer to tutor students grappling with those issues. Tutoring would be free but I would be asking students about their thought processes in the manner of Piaget. That might increase their time investment, but it could increase their understanding as well. The math people were very enthusiastic about this, but the education people regarded it as “too anecdotal.”
After the deadlock had continued for a year or more I submitted a new proposal: a history of the "new math" movement in the United States. I think that was an outgrowth of a paper I did for a History of Education course. That got approved right away, so that's what I did. At the meeting, Will Barnes said that most dissertations just end up gathering dust, and that since my topic was of potential interest to teachers, administrators, and school board members, it should be written for an educated layperson rather than for my committee. I don’t think there was any response, so I took the silence as permission to do as Will said—because I thought it was a great idea. I know a number of people have read it because I got royalty checks, letters about it, and it was cited by two of the books I know of published on the topic since then. I recently discovered that ISU has posted it online (Hayden 1981).

“New Math”

AR: Here’s my first impossible question, as I’m going to ask you to summarize your 271-page dissertation in a few paragraphs. I don’t know whether my asking more specific questions will make this impossible task easier or harder, but here goes: How did “new math” differ from what came before it, what were its goals, and what became of it?

RH: Well a summary will be easier if I opportunistically talk about the things I find most interesting today. The “new math” was unusual at the time in the degree of involvement from college mathematicians and the federal government. Today it is considered a failure, but that is because of problems in the elementary schools, which is where the public generally encountered “new math.” The high school programs were quite successful. They changed high school mathematics for decades. During that era, college math departments got the best trained incoming students they had ever seen—and the most interested in mathematics.

Part of the reason for that success was the many workshops used to train high school teachers to teach the new material. These were perhaps the model for the many workshops we now have for training high school AP Statistics teachers. But because of the costs and logistics involved, a much smaller fraction of elementary school teachers ever got such training. In addition, many more parents tried to help elementary school students with their math homework, and the new materials were Greek to them. The earliest “new math” programs had put heavy emphasis on pedagogy. In the interests of reaching a large audience, the widely used high school texts focused on new content rather than pedagogy. You could get away with that in the high school to some extent, but not in the elementary school. Hence the widely used elementary school materials were indeed a failure.

We are seeing something like that again today with Common Core. Once again there is a public outcry, and once again it has nothing to do with the inherent value of the program. In both cases it is aspects of the implementation that are rubbing people the wrong way. This past summer I attended a talk about Common Core by a critic. He was an M.D. and a school board member, not a raving lunatic, but in a one-hour talk he never addressed what the standards say—only a long list of issues he had with how it is being implemented.

AR: Around what year was "new math" introduced, and what was new about the content?

RH: A number of people were working more or less independently in the 1950s. I’ll mention two important ones. Bob Davis was an MIT math Ph.D. at Syracuse University. He volunteered to help out in an inner city junior high school where the kids were struggling with arithmetic. So Bob taught them group theory. Sounds insane, but he got them engaged. Every once in a while they needed to do a calculation and they would ask him for help. Big difference here—THEY ASKED HIM! So he told them, and they remembered, because they cared.

Max Beberman at the University of Illinois was an educator interested in students’ conceptual understanding. He consulted with mathematicians about the foundations of arithmetic and algebra in an effort to better understand what was involved. For Davis and Beberman the new math content was a pedagogical tool. When later efforts were made to improve mathematics instruction nationwide, many college mathematicians became involved. I think they tended to see the new content in the new programs but not to be as aware of the pedagogical reasons for it. There was also a desire for rapid change following Sputnik, and Davis and Beberman were asking teachers to make profound personal changes. Their programs were not at all suited to rapid dissemination, so they were largely left by the wayside. This resulted in a big discontinuity in what “new math” actually was.

Early Faculty Career

AR: Let’s return to your story after earning your Ph.D. Did you then pursue university positions for teaching mathematics? If so, how did prospective employers react to your unique, self-designed doctoral program?

RH: That’s an interesting question! I have no idea how the people that did not invite me for an interview responded. By this time I felt that the usual job-seeking strategy of trying to be all things to all employers would not work for me. I might get a job, but ultimately they would be unhappy with me, or me with them, or both! So I was happy to fend off colleges looking for someone to do mathematical research. On the other hand, I felt that a place really interested in teaching would see that I had taken a lot of initiative to prepare myself to do just that, while those applicants with conventional programs might appear to be frustrated researchers who did not get a position at a research university.

I should also say that this was all a long time ago, when regional state colleges were often teaching institutions that did not care about research. I did get an offer from Winona State in Minnesota. Your question reminds me of an incident that took place shortly after I started work there.

When I left UConn somewhat under a cloud, I asked the chair there what sort of reference I could expect. I was told I would receive a good one. When I finished my doctorate and started job hunting, I asked that chair for a reference. I specifically asked that it address my work there. I enclosed a transcript from ISU to indicate what I was up to now. I have never seen the resulting letter, but the chair at Winona told me that it devoted a sentence or two to non-committal
remarks about me, and then launched into a long diatribe about my program at ISU. The chair at Winona told me that he had met a lot of mathematicians like that, and as far as he was concerned, that letter was a feather in my cap. However, he also suggested I might want to try to have it removed from my placement file because it was very hostile. I never did. I thought it would protect me from being hired by a place with similar attitudes.

AR: That’s a good story and sounds like an interesting letter. What courses did you teach at Winona, and how would you describe your teaching approach and style at that time?

RH: For one thing, I taught remedial courses. Most math departments are short of volunteers for that. Ours packed a couple years of high school algebra into a ten-week course. I thought that was a lot to ask of students who did not master the material when they had two years to do it. I especially noticed some adult students who were highly motivated but just couldn’t keep up. So I fought hard and eventually got an option for students to take it spread over 20 weeks. I volunteered to teach that section the first time it was offered.

I had one of my life’s peak moments the first day of class. The tension there was so thick it was hard to breathe. I did not know what was wrong or what to do about it. At one point I asked for questions, and got, “How were you assigned to teach this class?” It seemed off the wall, but I took a leap of faith and described how I had discovered the need for such a class and fought to create it. You could feel the tension disappear. I think they felt they were being punished by being put in the “dumb” section and I must have been punished by being assigned to teach them. Once they realized I wanted to teach them, we were allies.

The last day to drop came around Valentine’s Day. I bought a big bag of candy hearts and took out all the purple ones. On the first class meeting after the drop deadline I gave each student who remained a purple heart. After that they referred to themselves as “The Purple Heart Section.”

At about the time I arrived in Winona, Tony Ralston had an influential paper in The American Mathematical Monthly (Ralston 1981). It prompted the creation of discrete mathematics courses in most mathematics departments in the years that followed. I became an advocate, and when Winona launched such a course, I was its teacher. My lecture notes eventually developed into a textbook which I used for years. I almost signed a contract with a publisher. The editor was very enthusiastic about having one of the first books on that topic, but the people above him vetoed it because they were not sure discrete mathematics would ever catch on. I don’t know if anyone would have liked mine, but before long there were dozens of texts on the market.

Winona at that time had an undergraduate statistics major within the math department. I don’t think any faculty actually had a degree in statistics, but it was a sound program set up under the guidance of Bob Hogg. Initially I taught an occasional section of introductory statistics. It was mandatory there that instructors use Minitab. Gradually the energetic people who had created that major redirected their attention to creating a computer science major, and left a hole in applied statistics. I fell into that hole, and went back to ISU for a summer to learn more statistics. I taught a regression course, an ANOVA course, and what is often called a calculus-based introductory course. I began attending all the statistics workshops I could find.

Toward the end of my time in Winona I became involved in Writing Across the Curriculum (WAC). As you well know, Allan, AP Statistics students are expected to do a lot of writing. I think every applied statistics course should involve student writing, and everyone teaching those courses should be involved in WAC. For me the key point is that a student cannot write about a subject until they think about that subject.

AR: Having studied so much about the teaching and learning of mathematics, what were your impressions as you studied more statistics and taught more statistics? Were you more struck by similarities or differences between how mathematics and statistics were taught and learned?

RH: I never really thought about that. Off the top of my head I would say there is more variability within mathematics than between statistics and mathematics. At the elementary level mathematics is typically taught as rote memorization and mechanical skills. There should not be much of that in statistics—maybe learning R syntax? Then the elephant in the room is axiomatic systems. Even math majors, including many future math teachers, struggle with those. They are an acquired taste, or more accurately, a usually unacquainted taste.

AR: You mentioned that your time at Winona came to an end. What prompted you to move on, and where did you go next?

RH: Unfortunately, the lively people there at the time didn’t trust one another. As time went on, and I remained lively, they didn’t trust me either. And I had always wanted to be back in New England. I decided it might be better for future job prospects if I resigned rather than failed to get tenure, so the year before my tenure decision I took a job at Plymouth State in New Hampshire. I won’t claim that my leaving caused this, but statistics has flourished in Winona since then, with the department now about evenly split between mathematicians and statisticians. I have had positive interactions with Chris Malone there a number of times over the years.

You know, as I look back on this interview it sounds like I really have trouble getting along with people. There may be some truth in that, but I think the main difference is that artist lifestyle. I am sure there were many others equally dissatisfied with their job or school, but who did not move on.

This time I chose a 20-year-old van to move in.

AR: Did you join a Mathematics Department at Plymouth State? Were there statisticians in the department? Did the department offer many statistics courses or a program of some kind in statistics?

RH: Yes, no, two. There was a rapidly growing business program which required an introductory statistics course and a regression course. I was hired to teach the latter. By then I was doing ANOVA (and ANCOVA) as regression models so my teaching assignment was not much different than it had been in Winona. I negotiated to teach their new discrete mathematics course, joined their Writing Across the Curriculum program, and lobbied for a remedial math course spread out over two terms.
AR: In keeping with my tendency to ask three questions at once: Did those statistics courses evolve much during your time at Plymouth State? Did you come to offer additional courses in statistics? Was your lobbying on behalf of remedial math successful?

RH: A two-semester version of one of our remedial courses was created but I am not sure I was involved in teaching that myself. I was pretty busy with discrete math and the two statistics courses. We also had some low-level math courses that experimented with more applications and technology and less pencil-and-paper work. Sometimes I volunteered to teach innovative courses lest they die for lack of staff.

The regression course was new so there was little past to evolve from. The introductory course changed in getting away from the arithmetic practice type of text toward texts with significant statistical content. We eventually agreed everyone would use Minitab, though some of the mathematicians used it very little. Progress was really in other areas. I lobbied hard to hire a real statistician, and soon Farid Kianifard joined us, and we worked closely. The department created a statistics minor.

I continued to seek more training. I had a little list: I would go to any workshop involving George Cobb, David Moore, or Dick Scheaffer. To my delight, those three joined to do a week-long workshop at Virginia Commonwealth University, which I attended. I met all three and this marked the beginning of my notoriety. Farid and I did a statistics course off-campus for high school teachers, and that led to a paper we did for the American Statistician (Hayden and Kianifard 1992).

“Missionary Work” With Mathematicians

AR: Wow, that must have been something to see George, David, and Dick presenting together! (I might mention that all three of them are previous subjects of JSE interviews.) Do you remember what any of your take-home impressions from that week were?

RH: My memories of the conference itself are mainly about Virginia and interaction with the other participants. Some of the mathematicians seemed to be resisting, but I think I earned a reputation as a “statistics sympathizer.” Subsequently David took an interest in my paper with Farid on in-service training in statistics for high school teachers, and Dick and I had dinner together when we both arrived too late at a conference to catch the official dinner. I recall some situation where my participation was in question and I felt I should make it clear I was not actually a statistician. George immediately made me an “honorary statistician.” In general, I was working on missionary work with mathematicians teaching statistics.

I became part of a loosely organized group of people supporting statistics education. I think this journal came out of that under the leadership of Jackie Dietz. A subset became an official joint ASA/MAA committee. The Virginia workshop became a model for many other summer workshops at sites across the country. One summer I was the person responsible for getting participants up and running with Minitab prior to their arrival at the workshop site. Generally the target audience was mathematicians teaching statistics. My experience with that was that mathematicians tended to adopt textbooks that emphasized what they were comfortable with—plugging numbers into a formula. So I started doing talks on selecting a textbook, which led to a chapter on that subject in an MAA publication. I continued speaking and writing on using writing in teaching statistics, and contributed a paper on that to another MAA publication. I think mine was the only one addressing introductory statistics.

AR: I like your description of “missionary work” with mathematicians who teach statistics, and I’ll have several questions about some of your specific experiences with that endeavor. But let me start with a very general question: How receptive to your mission were the mathematicians with whom you worked?

RH: If by “with whom you worked” you mean at Plymouth, I would say they were pretty resistant. However, I should say that we were a former state teachers college and the faculty fell along a continuum from research mathematicians to people with degrees in mathematics education. The latter end of the spectrum were very receptive. I think those people are used to the idea of curriculum standards and the possibility of change in lower division courses. With years of work the folks at the other end of the spectrum were convinced to use one of David Moore’s texts. David has many accomplishments, but a big one in my eyes is that he wrote high-quality statistics books that one could sell to mathematicians.

I think my experience was pretty typical, and I think we can capitalize on that. I would like to see ASA put more pressure on NCTM to demand teacher training programs include a statistics course that is good preparation for teaching Common Core or AP Statistics. That will be tough to enforce because when something new comes along there is a strong tendency for people to look at what they’ve been doing all along and, with considerable poetic license, conclude that it meets the new standards. One good way to be clear might be to include some items from past AP exams that would be far over the heads of students who have taken an arithmetic review course instead of a statistics course.

It is always important to have inertia on your side, and here I think most mathematics departments that train teachers would rather upgrade their existing course than launch an additional course for teachers. Of course, they might then delegate the teaching of statistics to the mathematics educators and moonlighting AP Statistics teachers, but it sounds to me like then everyone would be a winner.

By now I have drifted far from Plymouth. It’s really hard to know how much my writing and speaking influenced anyone. I do see that some of the radical ideas I expressed in the AP Community as much as 20 years ago are now considered standard. As far as overall progress is concerned, I think the state of textbooks is a very positive sign. When something new comes along there is a strong tendency for people to look at what they’ve been doing all along and, with considerable poetic license, conclude that it meets the new standards. One good way to be clear might be to include some items from past AP exams that would be far over the heads of students who have taken an arithmetic review course instead of a statistics course.

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AR: Speaking of textbooks, as you mentioned earlier, you wrote an article for an MAA Notes volume that contained advice for selecting a statistics textbook (Hayden 2000). Please summarize the highlights of your advice: What features make for a good statistics textbook, and what features characterize a poor choice?

RH: One thing I suggested was to look for an author who knows more than you do. Remember this was an MAA
publication so my audience was presumably mathematicians teaching statistics. Generally that audience favors books by other mathematicians teaching statistics who know no more about the subject than they. (I’ve already credited David Moore for breaking that pattern.) The same advice would apply to most high school math teachers teaching AP Stats. The College Board has been fairly effective in getting most of the teachers into excellent books with one or more statisticians as coauthors, but we continue to see people asking why they can’t use some lesser book that looks good if you don’t know too much about the subject.

My second point was to seek a book that discusses data rather than just plugging summary statistics into a formula. So we hope to see lots of real, raw data, EDA tools for exploring same, and the use of these tools to check assumptions. Looking back I wish I had put more emphasis on a point George Cobb made in an earlier survey of textbooks: that the exploration is the point, not the tools. Today there are lots of books that have “data analysis” in the title, and show you how to make a boxplot, but never use them for anything, including the job they were intended for—comparing multiple groups (Boxplots travel in herds). It’s a bit like a carpentry course that has students learn to identify tools by name but never asks them to build anything.

Then I suggested looking at the reading, technical, and mathematical level of a potential text. I got a lot of former and moonlighting high school teachers to go along with my radical textbook suggestions simply because they felt the students would or could read the book I recommended, but not its competitors. I did not say enough about technical level. What I meant there was whether the text discussed things like assumptions, rather than just how to do the arithmetic. Finally, considering my audience, I warned against a text that is mathematically over the students’ heads; which is to say, it should not assume much beyond the ability to use a simple calculator. Mathematicians tend to assume that revealing a formula will make things clearer to the student when in fact it may have an effect closer to a swift blow to the head.

Lastly I came back to the role of real data and insisted it appear in the exercises. Here is one example on that point that bothered me for years. Many texts gave raw data for all the exercises on paired differences, but only summary statistics for all the exercises on independent samples. So what do students learn about how to decide what test to use? Use the paired test if you have raw data! I was also a fanatic about providing raw categorical data instead of a summary such as a two-way table.

My final summary was to:

“...seek a textbook that has a qualified author, reflects current statistical practice, includes real applications, includes real data, looks at the (real) data, explains how real data are produced, provides a context for the data it uses, includes more concepts than calculations, interprets the results of calculations in the context of the data, checks assumptions for every inference, and asks probing questions about the data.”

I won’t claim any credit for the fact, but this looks a lot like what we do in AP Statistics now.

Looking back on that paper, I think the root of all those issues may be that statistics is taught (and textbooks written) by people who have never done statistics in the real world. That’s really quite odd! It would be surprising to see someone who had never played the piano go into the business of giving piano lessons, having students read a book on playing the piano, and then giving them a written test to see if they remembered what the book said. They wouldn’t even have to ever see a piano. Given my attitude on that, you might wonder why I am a supporter of AP Statistics. The answer is that the college course AP students get credit for will likely be even worse on that count. AP Statistics classes almost always use good textbooks, and the teachers are willing to learn. And while I have been known to complain about specific AP exam questions, those exams are of a quality far beyond 99+% of teacher-made tests. The AP exam enforces a high level of quality.

AR: Thanks for that description. I especially like your final summary and appreciate your emphasizing a closer look at a textbook’s exercises. I’m sure you’ll recall that George Cobb’s mantra in the textbook review framework he wrote (Cobb 1987) was to “judge a textbook by its exercises, and you cannot go far wrong.” Do you agree with that?

RH: I do remember that but I have always wondered if it was an excess of rhetorical flourish. A good counterexample might be Feller’s probability text. The exercises are great, but I suspect I am not the only reader that felt the exposition really did not prepare me to do the exercises.

I might well agree with George in a context where the lecturer gives all the needed information in a clear, complete, and accurate manner, but that is not the situation we’ve been talking about, nor the situation in which I’ve been working all my life. When math people teach statistics, the textbook may be the students’ best source of information, and the teacher’s only source. So I think the exposition is just as important as the exercises. Looking at it historically, I wonder if that impression comes from the fact that the exercises in David Moore’s books seemed much more revolutionary than the exposition. Well, I challenge you to do those exercises based on the exposition in a cookbook textbook!

AR: Do I remember correctly that you were a proponent of an introductory statistics textbook by Andy Siegel (Siegel and Morgan 1996)? What appealed to you so much about that text?

RH: Well, I still think it is the most student-readable intro stats text ever written. It was clear and it was warm. The closest thing today might be De Veaux, Velleman, and Bock (2016) with its corny sense of humor. I got great feedback from the sometime high school teachers who taught for us. Joan Garfield also used this book, and I think she required students to read the text outside of class and based her use of class time on the assumption they had done that. It also had about the lowest mathematical level I’ve seen. There were very few formulae. Most calculations were presented step-by-step verbally, somewhat like the instructions for completing an income tax return—except much shorter! Siegel provided review for the math he did need. For example the equations...
of lines were reviewed in the regression chapter. There was real attention to assumptions, and unlike most other texts, he offered some remedies for when assumptions were not met. For example, he did the sign test for the median, transformations for univariate data, and fitting curves to data. He also used EDA techniques throughout the text, and used boxplots as God intended (for comparing multiple groups)! He also did an amazing job of finding real data that illustrated the point he wanted to make.

Contrary to George’s mantra, the exercises were few and of variable quality, though many were very good. And the book hardly mentioned computers. So I wrote a Minitab Guide to go with it, and created 50 or so Minitab exercises which were mostly extended versions of exercises and examples in the text. They resembled the kinds of exercises David Moore used, but involved the computer. Many were long, multipart exercises that led a student through an analysis. I remember one student asking me what I was going to do when I needed more than the 26 letters of the alphabet to label the parts.

Involvement With AP Statistics

AR: You’ve mentioned AP Statistics several times. How did you become involved with teachers of this course?

RH: The College Board gave a roll-out presentation of AP Statistics the summer before the first classes began. I think it was a week long, and it was in San Antonio. I have no idea why I was invited! There I met Chris Olsen and we’ve been carrying on ever since. I think a major reason for my continued involvement with the course was the old listerv, followed by the online community. I don’t travel very well, and this was a way to be involved from my living room. I had had prior experience with a national committee that only met online. I also think I am a better writer than speaker. Really, I think of the AP teachers as the best class I ever had. And it’s lasted nearly 20 years!

AR: I must say that I think you’ve amassed an extraordinary reputation from your living room, as you put it, by donating your time and expertise so unselfishly and prolifically to other teachers through listservs and other online advice forums. Could you estimate how much time you put into this effort?

RH: No! This is a very long-tailed distribution with lots of outliers and skewness. As an example of an outlier, I just spent the better part of a day testing a pre-alpha of the 2016 version of Stats Homework (http://sites.berry.edu/vbissonnette/index/stats-homework/), a free statistical analysis program I think would be great for AP Statistics. On the other hand, many of my posts to the list are off the top of my head and done as fast as I can type. I have about 1000 posts at the web site and many more on the old listserv. But I don’t know how unselfish it is. I wanted to live the life of an artist, but my passion is teaching, not painting.

AR: I don’t want to spend our time debating your unselfishness, but I will point out that even artists occasionally like to receive remuneration for their creations, and you receive no income for your contributions to the AP Statistics listserv and community.

RH: Once in a while Chris Olsen treats me to a meal at a nice restaurant. I only really need to get paid if I have to attend meetings.

AR: Let me ask specifically about a posting of yours from March of 2015. You were somewhat critical of the minimal change in the AP Statistics curriculum since its inception nearly 20 years ago, and you wrote: “Twenty years ago there was much talk about AP Stats among statisticians with general excitement and support. Today what I see ranges mostly from indifference to seeing it as an obstacle to progress.” Can you elaborate on this?

RH: Sure. That’s elaborated in a paper I just wrote for Chance magazine (Hayden 2015).

Here I can give a summary and update. Back around the time the AP course began, Dick Scheaffer made an oft-quoted statement to the effect that there was then a greater consensus about what a first course should look like than at any time in his career. Well, I think that consensus was an outlier. Today many college courses are strongly influenced by resampling/simulations and by “big data.” So while AP may still be near the median, it is far from this new, long tail in the distribution of college courses. And the top people in college-level statistics education are out in that long tail. So they see AP Statistics as the past. These people have moved a long way in 20 years, even if not everyone has followed.

The update is that there are also some older revolutions that have taken place in name only, and that fact is an issue as well. One is exploratory data analysis. As George Cobb said in that mass textbook review you mentioned earlier, the attitudes are what matters, not the specific techniques. So textbooks have boxplots and “data analysis” in the title, but the attitudes are not there yet. I will believe they have arrived when we begin to give students rich real datasets and ask them to explore them and turn in a report on what they found. Some of the innovators in that long tail are concerned with modelling, which I see as an even greater emphasis on exploration.

Another incomplete revolution is in technology. We have computers in colleges and graphing calculators in AP, but they are used primarily to make it easier to do the things we did in 1950. I think the calculators are specifically designed for doing 1950 textbook homework problems, not grappling with real data. We need to revolutionize both what we do and how we do it. Computers are an essential tool for all of the above changes because they all require lots of computing power. I know computers are not free, but people are paying money to get rid of computers that will run R under Linux, or run StatCrunch online for a bit more.

As to why AP Stats is sometimes seen as an obstacle to progress at the college level, let me say it’s AP, not just AP Stats. My MIT calculus teacher had the same issue re AP Calculus in more recent times. The issue is that if you make radical changes to the first course at the college level, the AP course that used to match it no longer does. Giving credit for the AP course means limiting the second course to what can be done starting from the AP syllabus. You can’t assume students in the second course have lots of experience with resampling, R, and modeling if a good portion of the class did not see those topics in AP Statistics. So I see places that used to accept AP Statistics no longer doing so because it does not match the course they now offer. I should say this is not a problem with all courses at all
times. It’s a problem when there is rapid change in what is happen-
ing in college courses in a particular discipline.

AR: Thanks very much. I’ll add that I think AP Statistics is in a bit of a tight spot, because the purpose of AP courses is to try to replicate their college-level counterparts at the high school level. I agree with you that some introductory college courses in the upper tail (in terms of innovation) do not align so well with the AP course, but I might think that the issue is currently restricted to pretty far out in the tail. Many people have asked me in the past few years how a substantial change to AP Statistics can be effected, and my answer is always that people who want such a change first need to work on making the change widespread at the college level. I don’t think that’s come close to happening yet outside of the tail we’ve been discussing.

Oh dear, I seem to have violated one of the principles of good inter-
viewing by spouting off on my own rather than asking a question! Before I return to a “real” question for you, let me ask if you’d like to respond to my spouting.

RH: I agree that any AP course faces difficulty in deciding how closely to track changes at the college level. Should the AP course match the mode, median, or mean college course? Cur-
rently, AP Statistics matches two out of three of those. There is a cost to moving too fast as the course may become unaccept-
able as a substitute for college courses at the other end of the distribution. But there is also a cost in having moved from a position of high esteem among leaders in college statistics edu-
cation to a position of much lower esteem. I think that change in esteem is not so much because the AP course has not moved far enough as it is because the AP course has not moved at all.

So perhaps the question should be what changes could be made in the AP course to reflect current college trends without making the course a poor fit to the median college course. The AP course already includes “simulations” and inference for experiments, so why not actually do permutation tests, which are the basis for inference for experiments? I think that would improve how topics already on the syllabus are taught while moving in the direction college courses are moving. There is also the very old question of technology. If we are really serious about tracking college courses we should not still be using graphing calculators. I think that is an example of the age-old problem of a minimum requirement becoming a maximum attainment. I think the AP course should have been gradually upping computer requirements over the past 20 years. That’s really the main obstacle to all the other changes. AP was behind the times here when it began and is now very far behind the times.

While getting students computer access may be difficult, it should be much easier today. Stats Homework and R are free, while StatCrunch costs very little and JMP site licenses are very reasonable. You can order copies of the Bock–Velleman–De Veaux text bundled with Data Desk at negligible added cost. Most of these options run on very antiquated hardware. A place to put the computers can be a problem but churches, recreation centers, and libraries can be an option outside of school. We could put them in senior centers and housing for the elderly where students could entertain the old folks and teach them how to get online and get photos of the grandchildren. I would be happy just to see people brainstorming about how to do it. Instead I often get a “give up first and ask questions later” response.

Teaching Statistics Online

AR: I’m glad that my spouting produced such thoughtful elaboration from you. Let me shift gears and return to some questions about your biographical story. You’re no longer at Plymouth State but now teach online courses for Statistics.com. Before I ask about your expe-
riences with teaching online, please tell us about your decision to retire from Plymouth State.

RH: I began at Plymouth in 1985. Things started out well and gradually improved. I have already mentioned that we hired a real statistician two or three years later. Then in and around 1990 we suffered some real political setbacks. As a result, Farid left. I did not have that option because that year I was diag-
nosed with cancer and was not expected to survive anyway. But I have always thought it important to question authority, so here I am today being interviewed!

After treatment I found I was weaker and had a hard time working to someone else’s schedule. I cut my teaching back to three-quarter time and began to seek work I could do from my living room. The largest such task was coauthoring a high school mathematics textbook series, MATH Connections, in the mid-1990s. Some years the project paid Plymouth for my time and I did not teach at all.

This writing project was the result of an NSF grant to the Connecticut Business and Industry Association. That is not the sort of group that usually gets these grants, but they were concerned because they felt businesses were leaving Connecticut because they had a hard time hiring good help right out of high school. Their perspective influenced me in a number of ways. As a college professor I was very familiar with how well the high schools prepared students for college, but I had little idea how well it prepared them for work after high school. I was sympathetic, though. My classroom had a strong job orienta-
tion. A very common bit of boilerplate on my assignments was, “Write a brief summary of your conclusions for your boss who has never taken a statistics course.” I think I see traces of that influence in Common Core which tries to take care of both the college bound and the rest. I also see AP Statistics as a much more relevant course for those not bound for college than most of the mathematics courses offered in high schools.

Which brings us to my involvement with AP Statistics, beginning with the roll-out meeting in San Antonio the sum-
mer before the first offering of the course. There I met Chris Olsen and we have been trading insults and information ever since. I was also involved with a variety of joint ASA-MAA efforts. I also began writing book reviews fairly regularly and still do that today for MAA Reviews on-line: http://www.maa.org/press/maa-reviews. All of these projects were much more fun than teaching at Plymouth, so when the administration there decided I had to go back to full-time, I decided to take an early retirement instead.

AR: I’m delighted that your inclination to question authority has produced a happy long-term outcome following your illness. I’m tempted to ask for some examples of best insults that you’ve exchanged with Chris Olsen, but instead I’ll ask you how you came to be involved with online teaching.

RH: That is a very good idea as I am sure that if you pub-
lished any of my insults Chris would sue for equal time!
The online teaching is something I fell into gradually and my recollection of the steps is a bit fuzzy now. I know that within a year of my retirement I was contacted by Peter Bruce of Statistics.com about teaching for them. He had a couple of introductory courses that were not doing as well as he hoped. The guy who had been teaching them was brilliant and I think would be an inspiring teacher for graduate students but maybe not ideal for anxious beginners. So he asked me to teach those courses based on my reputation in statistics education.

I took them on and revised them quite a bit. I still teach one of them twice a year. That has evolved into a one-shot overview of statistics for folks who don’t want more (though I am sure Peter will be thrilled if it convinces them to try more). It’s about like a one-credit elective college course.

But the main thing I did at Statistics.com was to create a new series of three three-week courses that amounted to a normal college introductory course. I used the Bock–Velleman–De Veaux text. Our old text was far from the mainstream and had fallen out of print. I wanted something people would recognize as a good standard text because part of the plan was to get American Council on Education (ACE) accreditation for it so students could potentially earn college credit for the course.

I had another motive for changing the text. I wanted the online course to be a resource for high school teachers assigned to teach AP Statistics who had never taken an intro stats course or who took one long ago. The idea was to have a special summer offering for those folks and to entice Dave Bock to teach it. I picked Dave because of his posts on the old listserv. I thought he had a knack for giving answers that provided the teacher with just enough information to get them through tomorrow’s class, all stated clearly and concisely and correctly (statistically speaking). In contrast, my own posts, for example, tended to be more material such as instructions for the use of resampling software. Others added more material such as instructions for the use of resampling software.

You can see from this history that I do not have up to date information on who takes the courses or how many people take the courses. When I was involved in the actual teaching, the audience was extremely varied, and class size was roughly comparable to a small college—maybe 20 or 30 students to a class. As demand increased, we added sections. I think Statistics.com wanted to distinguish itself from the MOOCs that are out there now by providing individual attention to students. For the class I still teach all student questions get answered—and almost always within 24 hours. There are machine graded quizzes on which students get instant feedback as to score, routine exercises on which they get feedback from a TA, and more open ended assignments for which I provide feedback.

AR: What topics do you teach in the overview course that’s comparable to a one-unit college course? How many students do you typically teach in that course? Can you summarize the background and interest of a typical student in that course, or give us some sense for the variability in types of students? (I seem to have returned to my habit of asking three questions at once.)

RH: A short answer on course topics might be that we do the one variable goodness-of-fit test using both chi-squared and simulations. So the idea is not to teach every test anyone might ever use but just to teach one so as to get at ideas like $p$-values and “significance.”

Enrollments vary but are often in the single digits. Background varies even more. One group that shows up regularly is nurses. As quality techniques move into medicine they are suddenly bombarded with standard deviations and are trying to figure it all out without taking a full course. Another group seeks a quick refresher before starting a new job, assignment, or graduate school.

AR: What about the three three-week courses—who is the primary student audience, and how many students do you typically teach in a section?

RH: Well, first I should say that I have been out of touch with those courses for some time. I can give you the history as I know it. They were extremely successful in terms of enrollments. We went from an occasional introductory course to the new sequence starting six times a year. (Today it’s twelve times a year.) I took some of the “next” courses a student might take after that sequence and found a gap there so I added a fourth three-week course with an introduction to multiple regression and ANOVA. We used another version of the same text that was targeted toward a year-long college course. Several other people became involved in teaching all these sections and my role diminished. At one point, I think Michelle Everson was teaching most of the sections.

Meanwhile, though I am sure Peter was happy with the increased enrollments, I know he was disappointed that the new courses involved no resampling. That was a conscious choice on my part. To gain ACE accreditation I thought we should use a widely used and respected college textbook, and no such books involved resampling at that time. I first met Peter in his role as principal of Resampling Statistics back when that was an MS-DOS program. Peter was one of the earliest and most vocal advocates of resampling.

So my last connection with those courses was as a writer for hire to produce a text for the course that included resampling. An additional goal was to have a text students could access online at no additional charge. Statistics.com was then getting into a global market and U.S. textbooks can be very expensive overseas. So, I wrote a skeletal text that organized the statistical content. Others added more material such as instructions for the use of resampling software.

AR: What do you find to be the primary differences between teaching online vs. face-to-face, and what are some commonalities?

RH: I think I have already described some of the commonalities in that the courses I have been involved with provide a considerable amount of individual attention and can lead to college credit. Even so, it’s a bit impersonal. I have taken some of the more advanced courses and there highly motivated students engage in lively discussions. The introductory courses remain pretty quiet. I don’t feel that I am able to spot and encourage talent, nor to spot and help the struggling student. They are often indistinguishable from the unengaged students. I suppose a difference from my experience at Plymouth is that the unengaged students are no trouble at all. They do not come around with excuses nor beg for
extra credit work or make-up tests when their lack of engagement leads to poor grades.

Pop Quiz

AR: Please tell us about your family.

RH: You have already heard that I’ve led an unsettled life, so it should not be surprising that I never married nor had children. So, my family now is my four younger brothers and sisters, and my mother, who at 91 is still living on her own in a regular apartment just like a real person! The siblings are all good and interesting people. I am the only one with much interest in statistics, though one sister has a B.S. in mathematics and is married to a guy with a Ph.D. in mathematics. Those two are also the ones using Linux, so I am not the only nerd in the family.

AR: What are some of your hobbies outside of statistics and education?

RH: Well part of the life of an artist is that your work IS your hobby! So, I don’t watch TV or follow sports. I am passionate about classical music, and some folk music. I have been into photography since receiving a hand-me-down camera from an aunt. Left over from my years in engineering and before is an interest in the American Industrial Revolution. I gave a talk on that in Nashua this past summer. When I was younger I took cars apart but now it’s computers.

AR: What are some nonstatistics books that you’ve read recently?

RH: The Drama of the Gifted Child by A. Miller
American Phoenix by S. Kilbourne
The Secret of Childhood by M. Montessori
Reinventing Organizations by F. Laloux

AR: Which one of these did you like the best, and why?

RH: American Phoenix was the most fun to read. That’s a biography of a pioneer in the American silk industry. It was “homework” for a tour with some industrial archeologists of the area where the events in the book took place, which was within walking distance of my favorite Massachusetts village, Haydenville.

AR: I’ve never been to that village, but I do like its catchy name. You’ve mentioned that you’re not a travel enthusiast, but what’s one place you’ve been that you particularly enjoyed, aside from Haydenville?

RH: Canada. 1980–1985 I lived in the mid-west and came east each summer in my van. I always took one leg through the United States and one through Canada. And when I lived in Vermont during 2005–2011, I was within walking distance of Canada.

AR: Here’s another fanciful one: You can have dinner with three people of your choosing, anywhere in the world. But let me add a stipulation: The dinner conversation will be about statistics and/or education. Who would you invite to join you, why would you choose them, and where would you go?

RH: If that offer of time travel is still open I will meet W. G. Cochran, “Student,” and George Box. I could say John Tukey but I probably wouldn’t understand anything he said. And I’d only get in a fight with Fisher! The three I picked talk my language. And we will meet in the old Anderson House in Wabasha, MN. They no longer have a restaurant, but when they did they served local wild game along with more normal fare—all very good. I used to just go there for a night because it was so cool! One unusual feature was they provided guests with room cats if desired. The inn opened in 1856 and the rooms have furnishings to match—but nothing so precious you have to worry about spilling your drink. Which reminds me that we might have to haul in Guinness or whatever the lads want to drink—because we’ll be staying at the inn for a week!

AR: Wait a minute; do I understand correctly that a guest at this inn could request to have a cat in his room for the night? Then I’m going to have to insist that you allow me to join your party! Perhaps I could serve as a chronicler of your conversations.

Now I’ll move to a series of questions that I’ve used to collect data from students. Let’s start with some binary variables: Do you use a PC or Mac? Do you consider yourself an early bird or a night owl?

RH: I mainly use Unix or Linux. I have a PC for my photography hobby since cameras rarely come with software I can use on my main machine. I am allergic to Macs.

Early bird these days—night owl before I retired.

AR: And now a nonbinary categorical variable: On what day of the week were you born? (You can use www.distancofromto.net to calculate this distance.)

RH: Thursday.

AR: Next a discrete quantitative variable: How many Harry Potter books have you read?

RH: None.

AR: Here’s a continuous quantitative variable. How many miles do you live today from where you were born? (You can use www.distancofromto.net to calculate this distance.)

RH: Ninety-seven miles, though Mom was moved from one hospital to another during my birth and I am not sure just what town I was actually born in.

AR: What was your favorite class to teach?

RH: I would have to say discrete mathematics, though not for the content. I started teaching that when there were no textbooks out yet so I wrote my own. And because we never had more than one section, I did not have to coordinate with others. Those factors made it the course that was the most “mine” of those I taught over the years. It was also the only nonservice course I taught with any regularity; so, I had a smaller proportion of students who really did not want to be there. If you really want something in statistics I would offer the workshops I did for AP Stat teachers at St. Johnsbury Academy. Those were also wholly my own and the participants were wonderful!

Conclusions

AR: We’re nearing the end of my questions, so I’ll send a particularly difficult question to you now. Please dust off your crystal ball, and tell us what the most important change in statistics education will be
“Big data” is getting a lot of attention from statisticians—more attention than statistics education usually gets. But I don’t think many have noticed that one reason the computing people do not see statistics as relevant is that the traditional first course is NOT relevant to “big data.” And I would have to include the AP course here due to the choice of technology. If this does get noticed eventually, it could have an impact on the introductory course. Now if the past is any guide, the effect might be to just incorporate some lingo from “big data,” though it will be hard to fake it if the biggest data set in the course has 50 observations on three variables.

So what I would like to see is lots of data sets in the first course that are large enough to explore, and hardware and software that supports exploration. I don’t think we should turn the first course into a “big data” course but we can make it appear much more relevant to that use. We can also use “big data” ideas as teaching tools. For example, the notion of developing a model with part of the data and testing it on another part is a much simpler and more intuitive introduction to confirmatory analysis than the traditional one based on sampling distributions. And by developing a model, students could also get some idea of where those hypotheses they test come from. Most “big data” work is observational and I think it would be good if such data played a bigger role in the first course. When I look at textbooks (or research journals!) much of the data treated as a random sample is in fact observational.

AR: How optimistic are you that some of your vision for infusing “big data” ideas into introductory statistics courses will be realized in the next decade?

RH: It’s happening here and there already. The turf war over “big data” has the potential to push this much harder than the average attempt at educational reform. But then inertia is a very powerful force!

AR: Among all of your activities and accomplishments in statistics education, can you identify one of which you are most proud?

RH: I am not sure I can quote him exactly but George Cobb once called me one of his favorite burrs under the saddle of complacency.

AR: That’s high praise indeed! I would also reiterate my comment from earlier that I think your contributions to listservs and other discussion groups have had a very large and positive impact on the teaching of statistics at high school and college levels around the country.

Before I ask my final questions, thank you very much for taking the time to answer all of my questions with so much patience and thoughtfulness. What are your plans for the future?

RH: Our conversation has been fun for me and stimulated a lot of thinking. The future starts today, so first I want to continue the projects I’m involved with right now. That would include continuing to try to be a burr under the saddle of AP Statistics until Chris Olsen throws me out. I’ll try to contribute a mix of content knowledge and radical opinions.

Speaking of Chris, he and I have been providing feedback to Victor Bissonnette on his program Stats Homework. The current version is a notch above a graphing calculator but we hope to add some features and keep its current virtues. It runs anywhere Java runs—I use it in Ubuntu Linux. And it’s free. One big advantage over a calculator is that you can open files or paste data in from the Internet or wherever without having to do a lot of typing.

I hope to continue reviewing books for MAA Reviews. I do mostly statistics books and also bring any interesting new statistics books to the attention of the editor. A great many college students take their introductory statistics course in the math department, and it is often taught by someone who knows little more about statistics than what’s in the text. So, I think it is important that good introductory textbooks be brought to their attention, as well as more advanced books that can help them increase their understanding of the subject.

I would like to continue taking courses at Statistics.com—I’ve taken a couple dozen since I retired. But I am running out of courses of interest to me! Roughly ten of the courses I took involved using R. I was really excited by the 1998 Agresti-Coull simulation study that showed that the traditional method used in introductory courses for confidence intervals for a single proportion behaves quite poorly (Agresti and Coull 1998).

There are many other issues that come up in a first course that can be studied via simulations. David Diez has shown that the simple bootstrap works poorly for small samples—just the opposite of the claims made for it (https://docs.google.com/spreadsheets/d/1MNOCwOo7oPkrDB1FMwDzsYzvLoKrQsO1M2A/edit?pli=#gid=0). Tim Hesterberg (2015) has done further work on when the bootstrap does or does not work.

I would like to learn R well enough to do similar studies closely tied to issues in the introductory course (including many raised by teachers of AP Stat).

And lastly, and most ambitiously, I am toying with the idea of writing a skeletal introductory statistics textbook. It would not be anything a publisher would want to touch with a three meter pole so I would have to put it on my website. I would not have a vast number of examples, exercises, or data sets. My main goal would be to do a proof of concept for some of the radical ideas I’ve been spouting all these years. My fantasy is that people might find it worth reading long after I’m gone.

AR: I look forward to your continuing to be a burr and also to reading this textbook, and I hope that you stick around to discuss it with people for decades.

Now please suppose that you had been born in the year 2000 and so are just turning 16 years of age this year. What advice would the real you give to that 16-year-old you about education and career paths to pursue?

RH: I’ll base my advice to the young on what I saw as an advisor in my years at Plymouth. Many of my advisees were paralyzed with indecision. My advice is, “Just do SOMETHING.” If you start down one road, it may well be that the main thing you learn is that it’s the wrong road, but that’s more than you will learn if you stand still.
AR: Finally, let’s consider someone who believes that she has found the right road. What advice would you offer to a 22-year-old who has just completed her undergraduate degree and decided that she wants to pursue a career in teaching statistics?

RH: That is the toughest question you have asked me, Allan! I would not have much advice on textbooks or teaching—there are many good texts and tons of teaching resources out there today. I think the area where guidance might be helpful is in job hunting. I know that I have witnessed a lot of unhappy tales there, and heard still more from others. Usually it is over a mismatch between what the new hire wants to do and usually the institution values and rewards.

Perhaps overlooked option is teaching in industry. A large business might well have a quality program, and need a statistician to both direct that and provide training to others at many different levels. Such a person might also be involved in consulting, which is another form of teaching.

A statistics department at a large university would seem like an obvious place to apply for a job, but those places are often looking for researchers rather than teachers. I know many people that are happy at institutions that do not grant doctorates, so those might make a good target. Beware, though, of those who wish to become the Harvard of the Wilderness, with Harvard-like research expectations and regional state university pay and teaching loads. And speaking of regional state universities, those are often former teacher colleges that value good teaching. The thing to watch for there is inward-looking places where faculties are more concerned with internal politics than what is going on in their profession.

I would advise an applicant to interview aggressively and keep in mind that they can probably get a job in industry that pays twice as much. So act like you are valuable! Worry more about whether you will be happy working there than whether you can get the job. See what they are already doing in statistics. What texts are they using? What software (if any) are they using? What kind of exams do they give? Who teaches statistics now? Is statistics valued or dumped on junior faculty and part-timers? Do they want someone to lead their statistics efforts, or to follow the lead of senior faculty with little knowledge of statistics?

If things get serious, find out exactly what your job duties will be, and how you will be evaluated. Keep the original ad you responded to. Twice in my career I was in trouble for not doing something someone thought I was supposed to do, yet that task was not mentioned in the published job description. Does internal and external consulting count? Textbook publication? Talks on teaching? How do they feel about papers with coauthors? This is rare in mathematics, and mathematics departments often give little weight to such publications. If you can get answers, try to get them in writing.

If you love teaching, it might make sense to fight for a few months for a job that values teaching, rather than to take what job you can get and spend years fighting to survive in an environment that does not value teaching.

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